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OF THE

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THE AMERICAN ASSOCIATION OF GENITO-URINARY SURGEONS

FIRST DAY, MAY 17, 1923

AN ANTISEPTIC PYELOGRAPHIC MEDIUM

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Boston, Massachusetts

The work of previous authors, particularly that of Cameron (1), and that of Graves and Davidoff (2), has established the fact, we believe, that sodium iodide is the best available pyelographic medium, because this substance, in 12 per cent solution, possesses an excellent degree of opacity to the roentgen ray, is not irritating when applied to mucous membranes, and is not toxic when introduced in large amounts into the circulation. It is inexpensive, easily prepared, and sterilizes without difficulty. The viscosity of sodium iodide solution is essentially that of water, and its reaction is practically neutral. Furthermore, the ill effects of hypertonicity, an undesirable feature in some of the commonly employed media, especially sodium bromide, are reduced to a minimum. It lacks but one important quality—that of germicidal activity.

The advantages of an antiseptic pyelographic medium are obvious, but up to the present time no such solution has been available. The ideal substance must possess all the necessary features noted above, and at the same time that of antiseptic action.

In selecting a germicidal substance, our effort has been to take into consideration all germicides of common and ready access, and by a process of elimination to determine the one or several which would be most satisfactory. We have judged

that the acceptable material must be stable, and so strongly antiseptic that the requisite amount of it will have no material effect on the concentration and tonicity of the medium. It must, of course, be neither irritating nor toxic.

Inasmuch as 12 per cent sodium iodide has been offered as the most satisfactory pyelographic solution, it has been our effort to choose an antiseptic substance which would be miscible with it.

Colloidal antiseptics, such as argyrol, collargol, and colloidal silver chloride and iodide, are out of the question for colloids are precipitated by electrolytes, and would not remain in solution in the presence of 12 per cent sodium iodide.

Silver salts, so frequently used in the kidney and bladder, (silver nitrate 16)[1] yield with sodium iodide a precipitate of silver iodide more sparingly soluble even than silver chloride. Silver iodide is but slightly soluble in the solution under consideration, only 0.1 per cent concentration being possible in 12 per cent sodium iodide. This combination might have germicidal properties, but it becomes turbid from precipitation when diluted with water, and we have not investigated it further, on this account.

Oxidizing germicides, such as potassium permanganate (42), hydrogen peroxide, alphozone (succinic acid peroxide), Dakin's solution, hypochlorites (146–220), chloramine T. and dichloramine T., liberate iodine from the sodium iodide. They would be no better, therefore, than iodine itself. Iodine water (100) is a fairly vigorous germicide, but its potency is relatively low.

Phenol (1) is entirely too caustic and too toxic. While cresole (3.7) is less irritating and poisonous, it is still too feeble, as are also other phenols, such as guaiacol (0.9), resorcine (0.3), and pyrogallic acid (0.2). Bechhold and Ehrlich (3), have studied the effect of the introduction of halogens into the phenols, and find that one molecule of pentabromphenol has the same effect upon the diphtheria bacillus as 500 molecules of phenol

[1] The numbers given after the names of germicides are the Rideal-Walker carbolic acid coefficients (B. typhosus) as reported by Geoffrey Martin, "Indust. and Manf. Chem.," London, Lockwood, 1918, vol. 11.

itself. The effect of the halogen is still further magnified if methyl groups are also present; thus, tribrom-m-xylenol is 20 times as powerful as tribromphenol. Bechhold and Ehrlich state further that one halogen reduces and that more halogens increase the toxicity of the disinfectant. A methyl group, on the other hand, counteracts the tendency toward increased toxicity. Tetrabrom-o-cresole, which these authors say is perfectly inocuous, prevents the growth of the diphtheria bacillus in concentrations of 1:200,000, while a solution of 1 part of phenol in 800 is necessary to produce the same effect. Had not some other better known and more accessible substance proved suitable, tetrabrom-o-cresole would merit consideration for our purpose. It is not now listed in any of the American catalogues of pharmacological products, and therefore is eliminated.

With the exception of mercury compounds, the other common germicides are too feeble for our use; hexamethylenetetramine, acetylsalicylic acid, salicylic acid, phenylsalicylate, benzoic acid (5.0), iodoform, formaldehyde (0.5 to 0.7), zinc chloride (1.15), boric acid (less than 0.1), etc.

Mercuric salts are the most powerful of the usual germicides (mercuric chloride 400 to 3000). All of them, on treatment with sodium iodide solution, yield bright scarlet mercuric iodide, which is sparingly soluble in water, but which dissolves readily in sodium iodide to form a stable colorless solution of the complex double-salt: Na_2HgI_4. The poisonous action of mercuric salts, and the caustic effect of corrosive sublimate have been ascribed to the mercuric ion, following which belief certain organic compounds of mercury in which the mercury is in the un-ionized state have come into use as germicides. Mercurochrome 220, a dyestuff of the phthalein series, containing mercury in its molecule, has found much favor and is non-irritating to delicate mucous surfaces, in relatively strong concentrations. We find that a 1 per cent solution of mercurochrome 220 in distilled water does not contain mercury ions, for it fails to amalgamate a copper coin after several hours of contact. When sodium iodide is added, however, this situation no longer obtains, and mercuric iodide results. It is to be supposed that mercuric disuccinimide will behave in the same way. All of these con-

pounds give the same solution that mercuric iodide alone would yield with sodium iodide, and mercuric iodide is the only compound of mercury which can be considered.

Mercuric iodide unjustly enjoys a somewhat evil reputation because of the unpleasant circumstances which ensue when certain mercuric compounds are brought together with iodine or iodides in the same patient. The first degree burn, which is produced when gauze, moistened with corrosive sublimate, is allowed to rest on a cutaneous surface, painted with tincture of iodine, is not due to iodine, to corrosive sublimate, or to mercuric iodide, but to chloride of iodine, produced by the reaction $HgCl_2 + 2\ I_2 = HgI_2 + 2\ ICl$. Chloride of iodine is a very vigorous reagent, which will attack many organic substances not affected by iodine alone, and it is prepared frequently for that purpose in the laboratory by the addition of iodine to a solution of corrosive sublimate.

In the familiar pharmacological experiment in which calomel paste introduced into the eye of an animal which has been fed with iodides, produces a corneal ulcer, the effect is not due to mercuric iodide, but to actual metallic mercury deposited at the point where the calomel rests: $2\ HgCl + 4\ NaI = Na_2\ HgI + 2\ NaCl + Hg$. The incompatibility of mercurous iodide (the yellow iodide) with soluble iodides, is due to the same cause: $2\ HgI\ 2\ NaI\ Hg\ Na_2Hg\ I_4$.

Geoffrey Martin (4), says that mercuric iodide is less irritant to wounds than mercuric chloride, and does not coagulate albumen in the same manner. Hence it has been incorporated into several ointments and soaps. Macfarlan (5) reports the use of a 1 per cent aqueous solution of potassium iodide-mercuric iodide double salt on mucous membranes, and states that 5 drops of the 1 per cent solution were taken internally without injury. Park (6) gives the following table in the comparative review of antiseptic germicidal strengths:

Phenol	1:333
Calcium hypochlorite	1:1000
Silver nitrate	1:12,500
Mercuric chloride	1:14,300
Mercuric iodide	1:40,000

Mercuric iodide as an antiseptic has high potency and can be combined with 12 per cent sodium iodide in great dilution without destroying its gemicidal value. Furthermore, the solution as a pyelographic medium remains essentially unchanged so far as its physical characteristics are concerned. Sodium mercuric iodide is quickly prepared and it forms a stable compound. It is also noteworthy that the iodine content of the medium is made even greater than in 12 per cent sodium iodide alone, a fact which is of interest when it is recalled that iodine possesses a selective absorption apart from its atomic weight, so that the relative density of its shadow increases with increasing penetration of the roentgen rays.

We have decided, therefore, after consideration of all possible antiseptics in connection with a pyelographic solution, that 1:3000 mercuric iodide in 12 per cent sodium iodide is the most satisfactory. We find that sodium mercuric iodide of this strength has a phenol coefficient of 0.033. In other words it is comparable, on this basis, to 3 to 4 per cent carbolic acid. Used in equal amounts with a colon bacillus infected urine, it destroyed bacterial growth in two and one-half minutes. The solution retained in the mouth for a considerable period produces a salty taste, but no irritation of the buccal mucosa. Introduced into the circulation of a rabbit, it produced no significant change in the condition of the animal so far as heart, blood pressure, and respiration were concerned.

Of course the final test of this solution rests in its clinical application. It is employed routinely in our clinic and thus far we have observed no immediate or subsequent ill effects or discomfort, following its use in either the bladder or renal pelvis, even in the presence of active inflammation. The addition of the antiseptic sacrifices in no degree the value of the medium from the standpoint of the X-ray density.

In conclusion, we wish to recommend the use of 1:3000 mercuric iodide in 12 per cent sodium iodide solution, as an antiseptic pyelographic medium for two important reasons: (1) It reduces to a minimum the risk of introducing infection; (2) it provides some degree of positive benefit, apart from diagnosis, in cases in which infection already exists.

Preparation of the solution: The solution is prepared by dissolving 1 gram of mercuric iodide in 3000 gms. of 12 per cent sodium iodide. The latter is made with chemically pure sodium iodide and distilled water. The final solution does not need to be boiled.

REFERENCES

(1) Cameron, D. F.: Arch. Surg., 1920, i, 184–214.
(2) Graves, R. C., and Davidoff, L. M.: Jour. Amer. Med. Assoc., 1923, lxxx, 168–171.
(3) Bechhold, H., and Ehrlich, P.: Zeit. f. Phys. Chem., 1906, xlvi, 173–199,
(4) Martin, G.: Industrial and Manufacturing Chemistry. London, Lockwood. 1918, vol. 11.
(5) Macfarlan, D.: Jour. Amer. Med. Assoc., 1914, lxii, 17–19.
(6) Park, W. H.: Quoted by Macfarlan.

AN EXPERIMENTAL STUDY OF THE CIRCULATORY CHANGES IN HYDRONEPHROSIS

A PRELIMINARY REPORT RELATING TO THE UNILOBED KIDNEY AS INSTANCED IN THE RABBIT

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Before proceeding to note the circulatory changes in hydronephrosis of the rabbit it will be necessary to briefly outline the normal vascular distribution and its relationship to the pelvis and tubular system in this type of kidney.

In unilobed kidneys the renal artery divides at or near the hilus into an anterior and a posterior branch each of which go to supply approximately these respective halves of the organ. At this primary division is subject to variation, the areas of distribution are not constant. Each main branch on entering the sinus renalis proceeds to break up into a series of vessels—interlobar[1] arteries—which spread out in a radial manner and pass up on either side of the pelvis (fig. 2). On reaching the limit of their individual pelvic extension the interlobar vessels enter the base of the renal lobe at the junction of medulla and cortex and are thereafter known as arcuate arteries. Pursuing a curved course these arcuate arteries ramify, giving off numerous interlobular branches to the cortex and ultimately terminate, after repeated subdivision, themselves as interlobular vessels. From the interlobular arteries, which run parallel to each other through the cortex and at right angles to the surface of the organ, glomeruli arise by short afferent vessels of precapillary size. A limited number of glomeruli arise also directly from the

[1] The term "interlobar" used in association with a unilobed organ is obviously incorrect, but since it is the one most commonly employed, confusion will be avoided by leaving it so.

arcuate trunks (fig. 5). From each glomerulus is given off, an efferent vessel, which breaks up into a capillary plexus to supply adjacent tubules. These fine efferent vessels are modified in manner of distribution according to the zone in the cortex which their glomeruli occupy.

The cortex of the kidney presents three zones, a superficial or subcapsular zone, a cortical zone or cortex proper, and a cortico-medullary zone. The former contains no glomeruli and is consequently frequently also termed the non-glomerular zone as well as cortex corticis. It receives its blood supply from modified efferent capillaries of the most peripheral or subjacent cortical glomeruli, the efferent vessels of which on emerging, proceed upwards for an appreciable distance into this zone before breaking up into a capillary plexus (fig. 5, *A*). The parenchyma of the cortex proper, the next zone, is supplied by efferent capillaries which arise from an immediate subdivision of the efferent vessel of glomeruli in this zone. Somewhat contrary to the generally accepted teaching our findings in relation to the blood supply of the medulla show that the arteriae rectae arise as specially modified efferent vessels from the glomeruli situated at the medullary aspect of the cortex (fig. 5, *D*). In no instance have nutrient vessels been observed to arise direct from the trunks of the arcuate arteries, to enter the medulla. Thei nvestigation in proof of this fact was carried out in the sheep, dog, cat, rabbit, guinea-pig and rat, and substantiates the work of Huber. All the blood that passes through the kidney, therefore, must first pass through glomeruli whether it is that supplying the non-glomerular zone of the cortex, the cortex calicis or of the medulla, a zone containing only Henle's loops and collecting tubules. Strictly speaking there are no nutrient vessels to tubules. All tubular blood vessels are a secondary capillary network of a primary glomerulus.

The renal vasculature is also noteworthy in respect to the rapid reduction in caliber of its vessels. The exception to this being, the interlobar branches which from beginning to end of their course remain practically uniform in diameter.

The pelvis of one-lobed kidneys presents a calyx which is remarkably modified for the accommodation of the interlobar vessels that pass in intimate relationship to its walls (fig. 1). These vessels in their course appear to groove and displace the free margin of the calyx, which at the same time responds by developing the lips of the grooves so as to partially envelop these vessels and accompany them for a varying distance from the pelvis. According to the number and size of the interlobar vessels in the anterior and the posterior divisions, there will be a corresponding number and size of the leaf like projections of the calyx. In the middle of its course an interlobar artery is enveloped both laterally and mesially by this process extending from the cavity of the pelvis. All branches from the vessel at this point must emerge almost directly outwards. A few larger branches may be given off especially towards the termination of the interlobar trunk, at a less direct angle and these indent the margin of the calyx border accompanying the parent stem (fig. 2).

The arrangement of the main vasculature around the renal pelvis is such that the renal vein and its first subdivision lie in intimate association to the walls of the pelvis and central to the primary branching of the renal artery. After secondary subdivision into the interlobar branches, each artery with its accompanying vein lie side by side as they pass through the gutter or groove provided by the calyx margin. On emerging from these grooves and becoming arcuate vessels, the accompanying veins pass superficial to the arteries.

Having thus briefly reiterated the vascular arrangement and the relationship of the main trunks to the pelvis, let us consider the alterations produced in simple hydronephrosis of this animal.

In one series the left ureter was exposed through the lumbar route and divided between ligatures as far down as possible from the renal pelvis. In the other series, ligation and division of the left ureter was made just above the bladder through a mesial transperitoneal incision. The hydronephrotic changes produced by the two sites of ureteral ligation were similar except in so far that the higher obstruction favored a more rapid

development. The vascular changes were studied at varying periods by the following methods: (*a*) barium sulphate gelatine injection (Gross (2)); (*b*) celluloid corrosion (Huber (3)). With complete ureteral obstruction early pressure is transmitted from the distending pelvis to its leaf like calyces surrounding the interlobar vessels. These vessels soon find themselves subjected to increasing pressure as the calyx margins in distending come to surround them more and more. The interlobar veins appear to be chiefly affected at this early stage since sections of the formalin hardened kidneys show collapse of their lumen even on the fourth day. A resulting hyperemia may be noted in the cortex corticis.

The intrapelvic pressure gradually forces back the ampulla of the solitary pyramid, foreshortening the depth of the medulla. This reacts on the contained medullary "straight vessels," i.e., arterae and venae rectae, making them tortuous (fig. 17). As the medulla towards the poles of the kidney is subjected to a process of stretching rather than foreshortening by the forced recession of the ampulla, the "straight vessels" at these places are elongated and laterally compressed. As distention continues the pyramid becomes compressed on its base against the renal capsule thereby implicating the parenchyma of the cortex. In this process the blood vessels running primarily in the same axis as the direction of pressure become foreshortened and accordingly tortuous. The "straight vessels" of the medulla as already noted, suffer first. They are followed by the interlobular vessels in the cortex. The cortex corticis after a short period of venous congestion becomes thinned and then obliterated by compression against the capsule. The interlobular vessels soon show marked tortuosity with obliteration of their peripheral glomeruli and a temporary increase in size of their proximal glomeruli—those situated toward the medulla (fig. 16).

As the bloated lips of the calyces merge with the continued pelvic distention and bulge outwards, they displace the interlobar trunks. These trunks with their continuations, the arcuate vessels, now find themselves being stretched over a constantly dilating sac. Like elastic tubes these vessels as they

are stretched lose the diameter of their lumen. The branches arising from them are similarly affected. By the reduction in caliber of the main trunks due to pressure and stretching there is probably a diminished flow of blood to and from the cortex, producing a partial anemia of the cortical parenchyma. As pointed out by Kornitzer (4), this tends to lessen the normal tissue tone and favors a relaxation which is readily taken advantage of by the process of distention.

Owing to the peripheral pressure exerted by this steadily enlarging sac the larger interlobar and arcuate vessels become more and more attenuated and lengthened whereas their finer ramifications, i.e., interlobular branches which pursue a course radial to the source of pressure, pass from a stage of foreshortening to complete obliteration.

Thus by a progressive dilatation, the pelvis with its numerous leaflike calyces so alters its original character that the kidney becomes transformed into a thin walled sac, over and around which, course attenuated and much lengthened interlobar and arcuate trunks, sole remnants of the previous renal vasculature.

The correlation of these vascular changes with the progressive tubular alterations in hydronephrosis is essential to a complete understanding of hydronephrotic atrophy. This preliminary anatomic study demonstrates that circulatory conditions constitutes a considerable and important factor in the process.

REFERENCES

(1) Groetzel: Frankfurter Zeitschrift f. Pathologie, 1911, viii, 34–79.

(2) Gross, L.: Studies on the circulation of the kidney in relation to architecture, and function of the organ in health and disease. Jour. Med. Research, Boston, July, 1917, xxxvi, no. 3, 327–335; ibid., 1918–1919, xxxviii, 379–384.

(3) Huber, G. C.: The arteriolae rectae of the mammalian kidney. Amer. Jour. Anat., 1906–1907, vi, 391–406.

(4) Kornitzer, E.: Zur Entstehung des hydronephrotischen Nierenschwundes (Vorläufige Mitteilung). Zeitsch. f. Urol. Chir., July 31, 1922, ix, no. 4/5, 165–170.

FIG. 1. THE TYPE OF PELVIS IN UNILOBED KIDNEYS FROM A WAX INJECTION PREPARED BY THE METHOD ADVOCATED BY GROETZEL (1)

The leaf-like type of pelvis provides gutters or grooves along which the main vessels pass. Note small grooves for smaller branches and Y-shaped grooves for a bifurcating trunk.

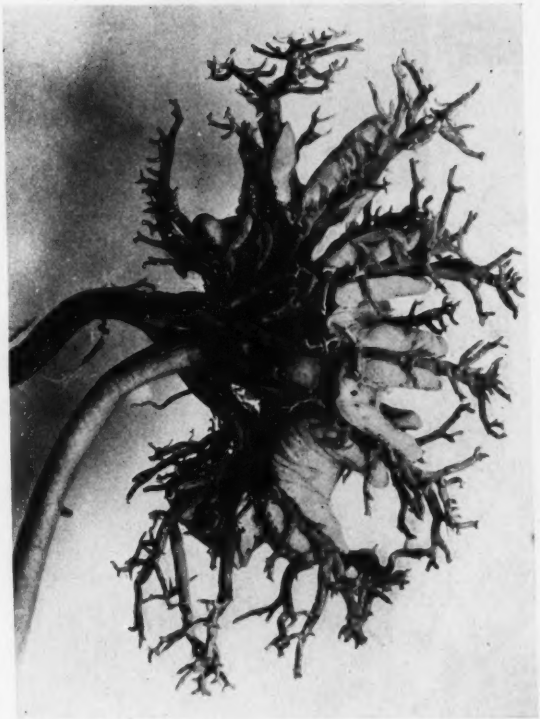

FIG. 2. CELLULOID CORROSION PREPARATION TO ILLUSTRATE THE RENAL ARTERY AND ITS MAIN BRANCHES IN RELATION TO THE PELVIS IN A UNILOBED KIDNEY (DOG)

Note the "interlobar" arteries passing along the grooves provided by the margin of the calyx.

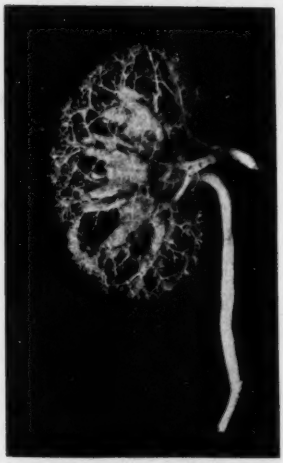

FIG. 3. CORROSION PREPARATION OF RABBIT'S KIDNEY SHOWING PELVIS AND MAIN ARTERIAL DISTRIBUTION

Note similar arrangement as in figure 2

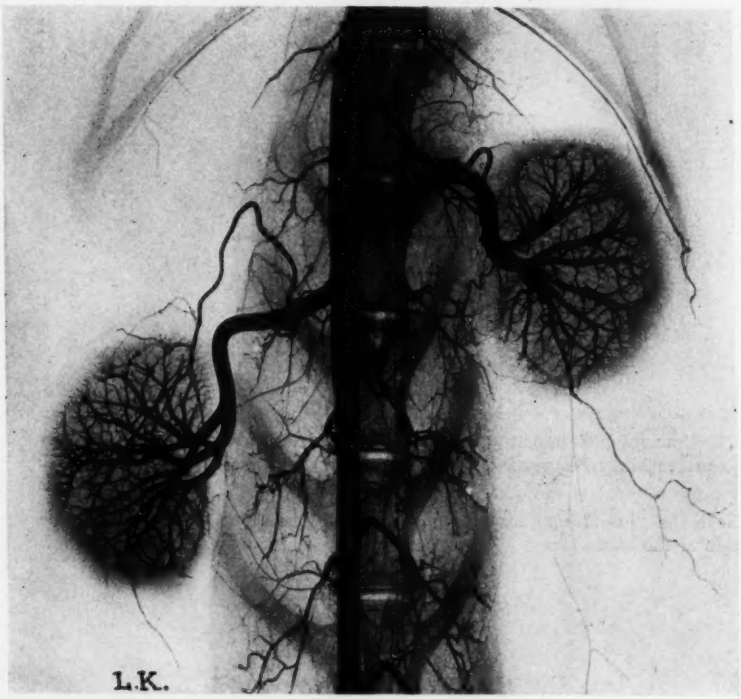

FIG. 4. RABBIT—NORMAL. BARIUM SULPHATE ARTERIAL INJECTION OF BOTH KIDNEYS IN SITU

Note distribution of the larger branches and the fine interlobular vessels at the periphery.

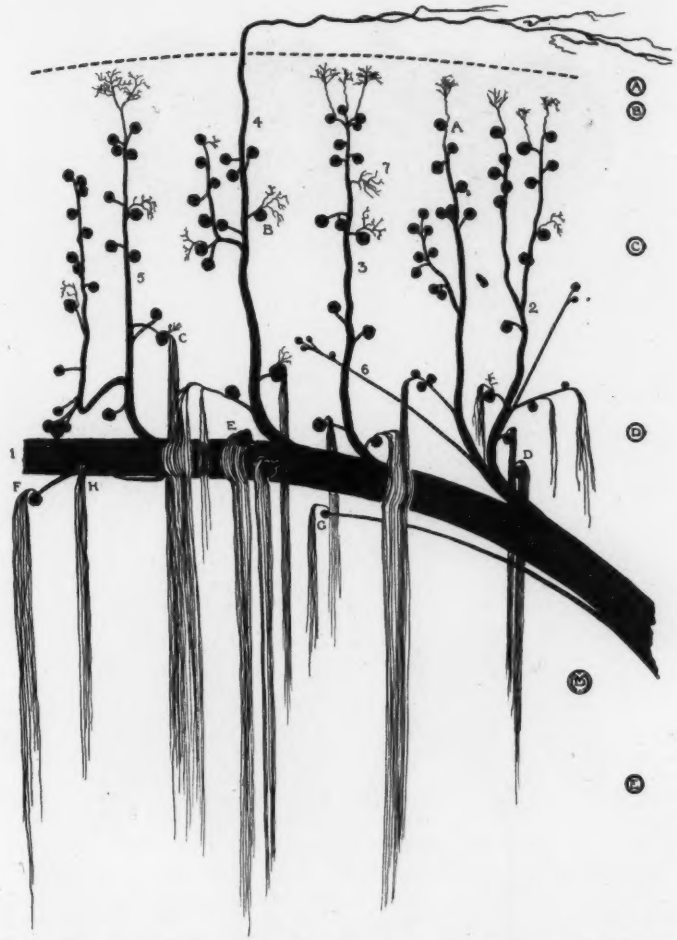

FIG. 5. DIAGRAM REPRESENTING THE FINER ARTERIAL DISTRIBUTION OF THE KIDNEY

A, capsule. *B*, "cortex corticis" or non-glomerular zone. *C*, cortex proper. *D*, medullary portion of cortex. *E*, medulla with arterial rectae. *l*, arcuate artery giving off interlobular branches into cortex.

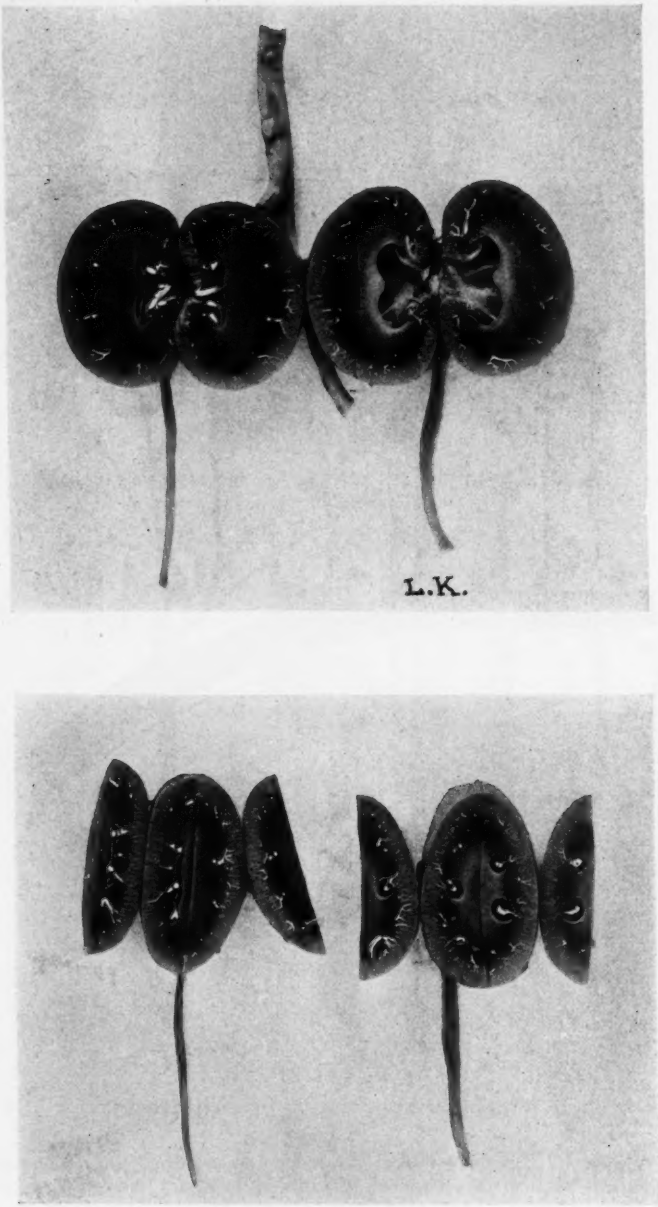

FIG. 6. HYDRONEPHROSIS OF LEFT KIDNEY, FOUR DAYS DURATION. SPECIMENS INJECTED WITH BARIUM SULPHATE

A, longitudinal sections of both kidneys to show relative pelvic changes with accentuation of ampulla in left kidney. *B*, coronal sections of same kidneys to show extent of dilatation of calyces around interlobar vessels compressing them.

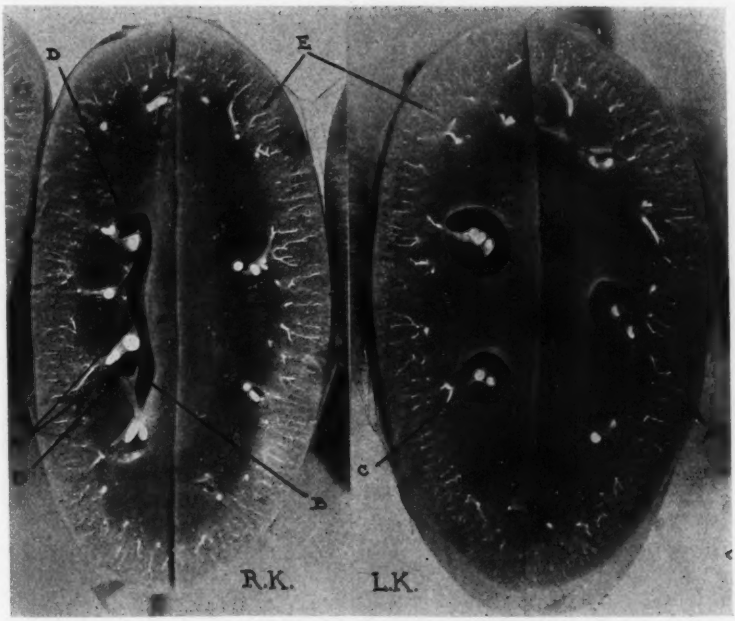

FIG. 7. DETAILED VIEW OF SPECIMENS REPRESENTED IN FIGURE 6, *B*, TO SHOW IN THE NORMAL RIGHT KIDNEY THE POSITION OF THE INTERLOBAR VESSELS IN RELATION TO THE PELVIS WITH THE LUMINA OF THE VEINS PATENT

In the left four day hydronephrotic kidney the pelvic extensions almost completely surround the interlobar vessels, exerting sufficient pressure to occlude the veins. *A*, cavity of calyx. *B*, cavity of pelvis. *C*, interlobar arteries. *D*, interlobar veins. *E*, interlobular arteries.

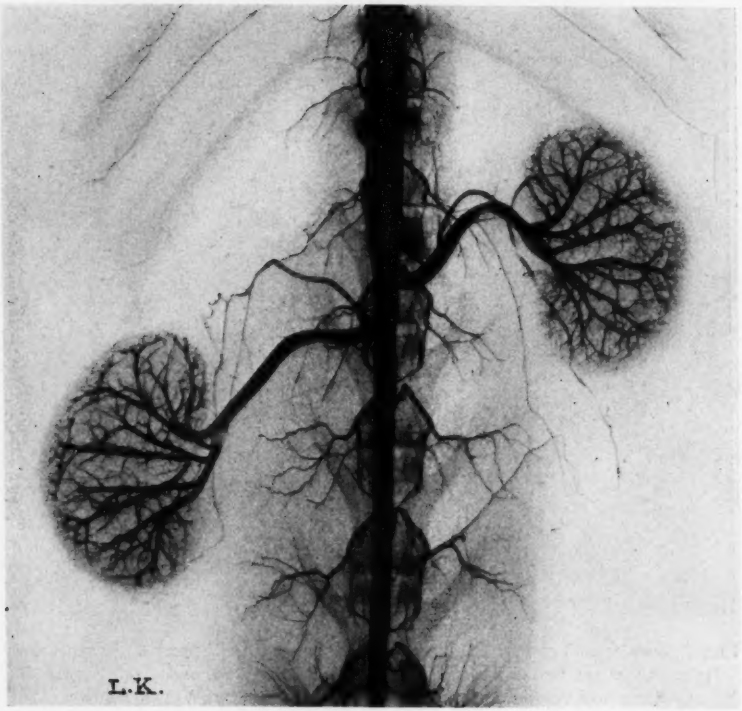

FIG. 8. HYDRONEPHROSIS OF LEFT KIDNEY, FOUR DAYS DURATION. BARIUM SULPHATE PREPARATION IN SITU

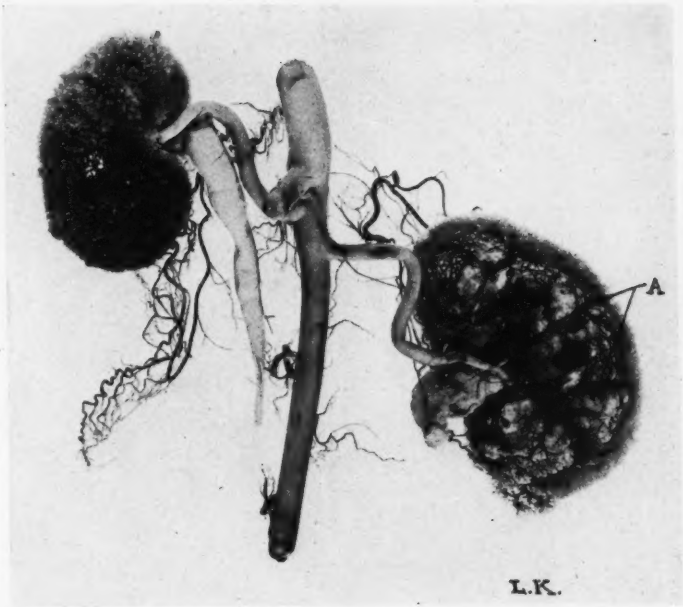

FIG. 9. HYDRONEPHROSIS OF LEFT KIDNEY, NINETEEN DAYS DURATION

Ureter was ligated through lumbar route. Corrosion preparation showing injection of both kidneys from aorta. The ureters on either side were also injected. Note the distended left pelvis and the bloated lips of the calyces compressing the interlobar arteries (*A*).

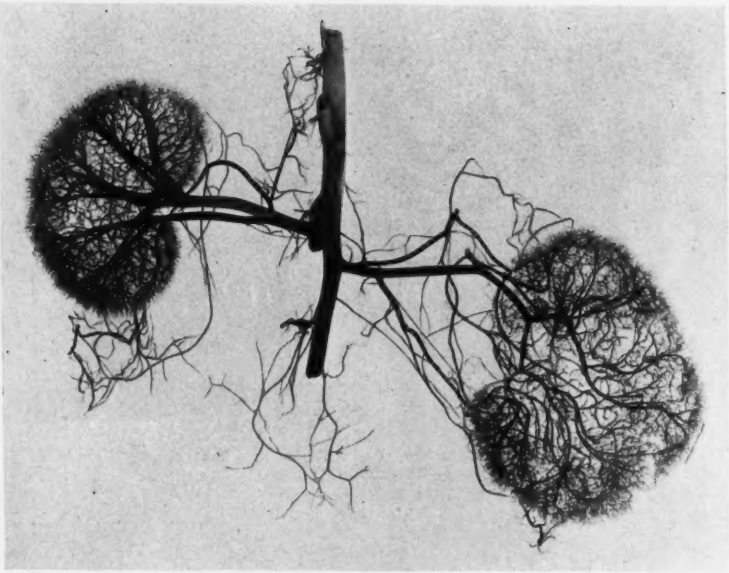

FIG. 10. HYDRONEPHROSIS OF LEFT KIDNEY, TWENTY-SIX DAYS DURATION

Corrosion preparation showing portion of aorta with complete distribution of each renal artery. Compare the altered vasculature of the left kidney to that of the normal right. The elongation and attenuation of the renal branches from the primary subdivisions to the arcuate vessels is well shown, together with the foreshortening and tortuosity of the fine interlobular branches at the periphery.

FIG. 11. GREATER DETAIL OF PORTION OF HYDRONEPHROTIC KIDNEY, REPRESENTED IN FIGURE 10, SHOWING ARCUATE ARTERIES (*A*) GIVING OFF TORTUOUS AND FORESHORTENED INTERLOBULAR BRANCHES (*B*)

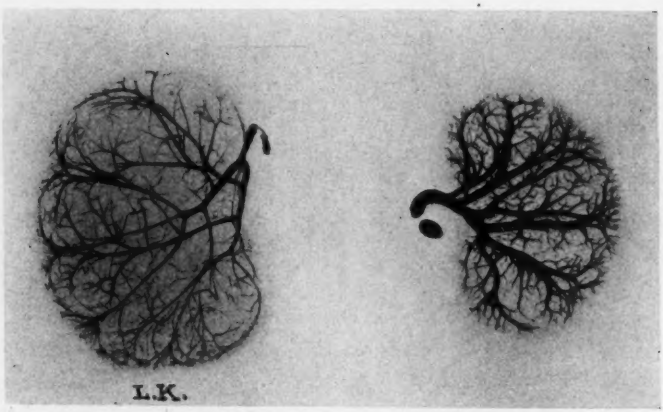

FIG. 12. HYDRONEPHROSIS OF LEFT KIDNEY, TWENTY-EIGHT DAYS DURATION. BARIUM SULPHATE INJECTION

There is marked stretching and attenuation of the interlobar and arcuate vessels together with almost total disappearance of the fine interlobular branches at the periphery.

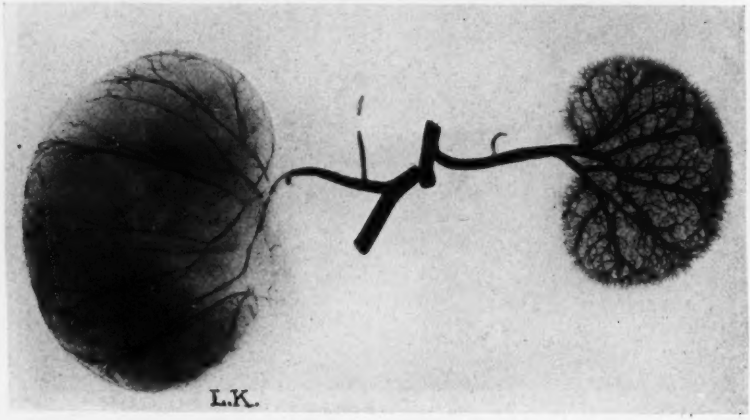

FIG. 13. HYDRONEPHROSIS OF LEFT KIDNEY OF EIGHTY-FOUR DAYS DURATION. BARIUM SULPHATE INJECTION

Showing an absence of the fine interlobular vessels and reduction in number of the lesser arcuate and interlobar arteries.

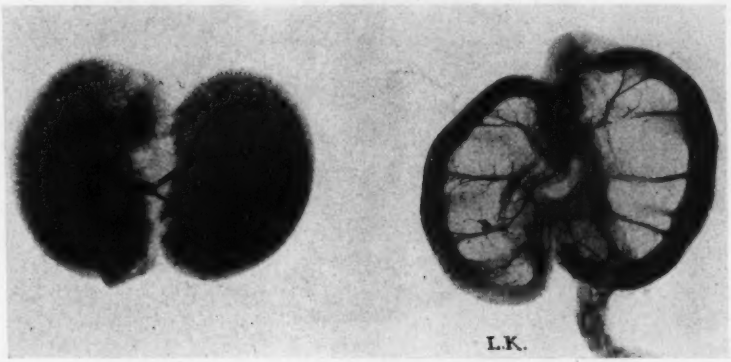

FIG. 14. HYDRONEPHROSIS OF LEFT KIDNEY, ONE HUNDRED AND SIXTY-EIGHT DAYS DURATION. BARIUM SULPHATE INJECTION

Note progressive atrophy of all the lesser arcuate and interlobar arteries.

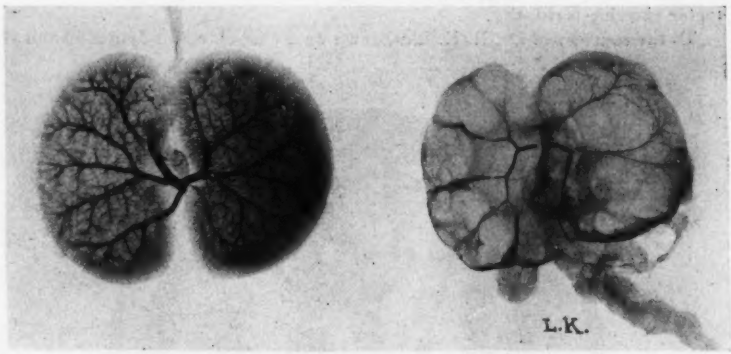

FIG. 15. HYDRONEPHROSIS OF LEFT KIDNEY, FOUR HUNDRED AND THIRTY-SIX DAYS DURATION. BARIUM SULPHATE INJECTION

The left kidney has now been converted into a thin-walled sac over which course attenuated and much lengthened interlobar and arcuate trunks.

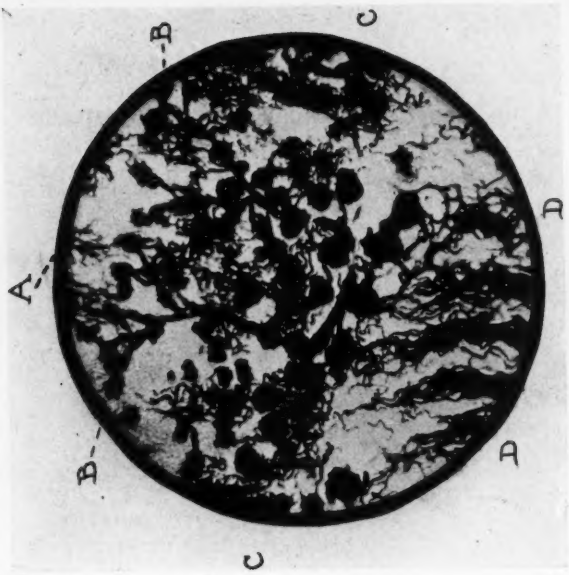

FIG. 16. SECTION OF HYDRONEPHROTIC KIDNEY (RABBIT) AT PERIOD OF EIGHTH DAY, PREPARED BY INTRA-VASCULAR STAINING AND CLEARING

A, capillary plexus in cortex corticis. *B*, commencing obliteration of peripheral glomeruli. *C*, enlarged glomeruli at cortico-medullary zone. *D*, arteriae rectae showing tortuosity.

To the courtesy of Dr. R. K. Lee-Brown we are indebted for figures 16 and 17.

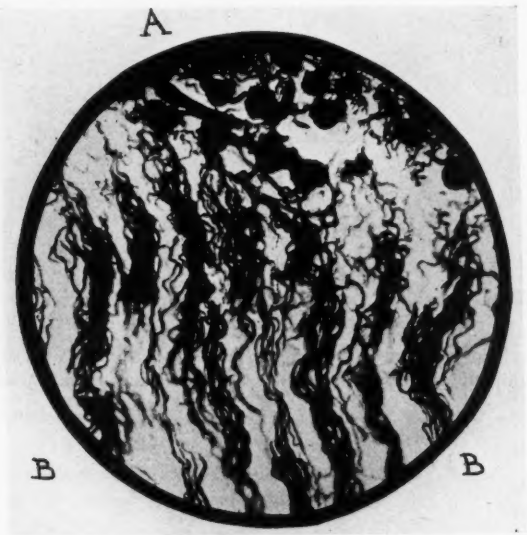

FIG. 17. SAME SECTION AS ILLUSTRATED IN FIGURE 16. A VIEW ILLUSTRATING THE ARTERIAE RECTAE MORE PARTICULARLY

The foreshortening and tortuosity that these vessels undergo is here well shown. *A*, congested glomeruli. *B*, arteriae rectae.

PLATE 1

URETERS FILLED WITH BLUE FLUID AS A RESULT OF REGURGITATION OF THE VESICAL CONTENTS

STUDIES ON THE URETER AND BLADDER WITH ESPECIAL REFERENCE TO REGURGITATION OF THE VESICAL CONTENTS[1]

ROGER COLGATE GRAVES AND LEO MAX DAVIDOFF

Boston, Massachusetts

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INTRODUCTION

The controversy concerning the route by which bacteria reach the kidney in cases of renal infection has waged for many years. The early theory that all such diseases occur as a result of direct ascent of infectious material from the lower parts of the urinary tract has been denied in many later writings. Indeed it has given way to the view that these infections are blood-borne in every instance. The latter belief has been so firmly upheld in recent years that we have been led to feel, rather generally, that the ascent of infection along the ureter is a most remote possibility, if indeed it occurs at all. And there seems to be ample justification for this opinion. On the one hand there exists a paucity of evidence that ascending renal infections are clinical possibilities. On the other hand, we are confronted by definite experience and by indisputable facts concerning the kidney and its relation to bacteria carried by the blood stream. It has been repeatedly demonstrated, for example, that in general infections, viable microörganisms may be excreted by the kidneys without those organs presenting any evidence of local disease. It seems indeed to be an important renal function to aid in ridding the body of infectious material, and how far-reaching this rôle may be has as yet never been adequately determined. As has been

[1] From the Laboratory of Surgical Research of the Harvard Medical School.

said, with normal conditions in the urinary system the kidneys themselves do not suffer in this process. When, however, there is present for any reason—such as injury to the kidney or disturbance of its circulation—lowered resistance to infection, the picture becomes a very different one and the patient presents all the signs and symptoms of active renal disease. Probably of chief importance, in this regard, is interference with the normal outflow of urine, caused by obstruction, acute or chronic, at any level in the urinary tract. When there is stasis of urine and bacteria then are brought to the kidney, local infection becomes inevitable. In recalling these facts we are simply again reviewing that which has reached our attention many times and conspicuously through Quinby in recent publications.

Without further discussion, it may be said that we know, both from experimentation and abundant clinical experience, that hematogenous infections of the kidney occur and that they probably predominate. However, the attitude that the blood stream is the only route of invasion does not seem reasonable, in spite of the fact that concerning the alternative, there is no positive proof. All of us are familiar with cases which suggest most strongly an ascending infection; indeed there are instances in which no other explanation seems probable. The following clinical picture is often seen and may be cited as a single example:

A patient whose bladder has previously been determined by cystoscopy to be normal as far as the ureteral orifices are concerned, has had a suprapubic prostatectomy performed. The convalescence has been uneventful and the temperature consistently normal. The suprapubic drainage tube has been removed. At the time when the sinus is almost completely closed and normal urination has not yet been well established, there suddenly occurs a chill followed by a rapid rise of temperature and all of the usual signs and symptoms of pyelitis.

This we have seen repeatedly and it is difficult to explain in any way other than that infectious material has been suddenly transported from the bladder to the kidney along the ureter.

Because of highly suggestive clinical evidence pointing toward ascending infection, and because the work on this subject has left

many points undetermined, it has seemed to us worth while to undertake its more complete investigation. By ascending renal infection must be understood, of course, the passage of bacteria from the bladder to the kidney along the path of the ureter, either through its wall or by way of its lumen. Three types are conceivable.

1. Extension of infection upward along the ureteral wall through its lymph vessels. There is little evidence on anatomical grounds for such an occurrence, the lymphatics of the ureter being arranged segmentally instead of continuously from bladder to kidney; but even if anastomosis between the segments permits a continuous lymph stream, the considerable amount of experimental work done on the subject has failed to prove, satisfactorily, that infection ascends along this channel.

2. Extension of infection along the lumen of the ureter through and against the column of descending urine. A passive ascent of this sort can only take place, obviously, in those cases in which disease of the ureter distorting the intravesical segment makes possible a free communication between bladder and renal pelvis. Such conditions exist, are fortunately not too common and need no further comment. In fact they should hardly be included as examples of ascending infection, in that the general disease of the urinary tract has long been present and the situation that we are describing is simply one of its results.

3. Extension of infection along the lumen of the ureter, anatomically intact, inwhich the bacteria are carried upward through the force of bladder regurgitation. It is this highly interesting possibility with which we are concerned, and we find that it has already been made the subject of a considerable amount of investigation.

Credit for the first efforts along these lines must be given to Semblinow who in 1883 determined with experimental animals that regurgitation of the vesical contents is possible under normal anatomical conditions. He produced reflux by mechanical stimulation of the ureter in a dog whose bladder had been filled with colored fluid. He believed that the phenomenon depended upon a combination of "various movements of the ureter and bladder" among them being ureteral antiperistalsis.

During the years between 1893 and 1898, Lewin and Goldschmidt started the first real study of reflux under conditions of normal anatomy. They used anesthetized rabbits, the bladders of which they distended with colored fluid through a urethral catheter. By these means they were able to produce regurgitation in a considerable number of attempts. They described two types of bladders—those which contracted firmly about the distending fluid and which usually produced regurgitation; and those which seemed incapable of vigorous contraction and which "never" gave reflux. "In spite of most intense observation" they were unable to determine any relationship between the phenomenon and the peristaltic activity of the ureter. Lewin and Goldschmidt were convinced that regurgitation was an established fact and that ascending infections might be explained upon that basis. They suggested as the factors necessary for its production:

1. Some influence acting to open the ureteral orifice (such as chemical change in the bladder and the impact of infected fluid).
2. A vacuum suction action of the ureter.
3. Bladder pressure.

They further interested themselves in the fate of particulate matter which had been carried to the kidney by the regurgitant stream, and demonstrated the ease with which this material gains access to the circulation and the distant organs, though they were unable to define accurately its route through the kidney. This ready communication "between the bladder and heart" was spectacularly demonstrated by cases in which they distended the bladder with air to the point of reflux and produced death of the animal by air embolism.

Courtade and Guyon in 1894 also began a study of regurgitation. Their methods were similar to those of Lewin and Goldschmidt except that they made use of a mercury manometer in order to measure accurately the intravesical pressure. In a series of 32 rabbits they produced regurgitation in 62.5 per cent of the cases. Using dogs, they were able to secure regurgitation in only 5 of 38 attempts (13 per cent). They ascribe the difference in results in the two kinds of animals to the stronger bladder

musculature found in dogs. They attached great significance to the muscle bundles overlying the intravesical segment of the ureter in the dog, the cutting of which permitted reflux in some of their cases. They concluded that "when the bladder, endowed with sufficient tone, resists the distention in a precocious fashion, reflux is possible however small the quantity injected may be, as soon as the pressure produced by the tone of the bladder musculature reaches at least 15 mm. Hg in rabbits and 50 mm. in dogs." They believed that regurgitation was probably not impossible in humans, so far as experimental analogies could be permitted and that it probably could occur with the sudden tension produced by injection. They felt that it was not likely to happen in cases of retention because in their work they were unable to cause the phenomenon by artificially produced bladder contractions.

In a paper concerning the hydraulic distention of chronically infected, small contracted bladders, Dr. Young, in 1898, considered the possibility of reflux, and concluded that the normal ureteral valve and the oblique course of the ureter in the bladder wall afforded adequate protection against it. He stated that he had never produced ascending renal infection as a result of his method of forced distention of these diseased bladders. By way of experimental confirmation he filled to the limit of capacity the bladders of cadavers, and failed to obtain regurgitation. He was equally unsuccessful with two living dogs.

In 1903 Sampson in an admirable study considered the possibility of regurgitation particularly in ureters that had been freshly transplanted. He filled the bladders by means of a needle passed through the vesical wall and attempted thus to produce reflux. He concluded that "a reflux from the bladder into the normal ureter in dogs must be rather unusual if I have been unable to produce it at the time of operation, in 16 animals."

In the same year, Marcus, continuing the work of Lewin and Goldschmidt, had no difficulty in producing regurgitation in rabbits. He was chiefly interested, however, in the study of the distribution of particulate matter following reflux. He believed that the ready entrance into the circulation could be ascribed to minute ruptures in the renal pelvis with direct escape of the particles into the venous blood.

Wislocki and O'Conor (1920) secured regurgitation in 10 of 14 rabbits and in 1 of 3 dogs. Their conclusion of the mechanism of reflux was that "when the bladder is moderately distended and of good tone, the uretero-vesical sphincter is occasionally prevented from closing as it normally does after each gush of urine and the intravesical pressure projects a column of fluid into the ureter."

In addition to the experimental work above noted, Kretchmer, in 1916, made an exceedingly valuable clinical contribution to the problem. He observed in a study of the normal bladder by means of cystograms, as an incidental finding, that the ureters often filled with opaque solution. This regurgitation occurred 3 times in a series of 10 normal children under ether anesthesia. In one adult also, with a normal urinary tract as proved by cystoscopy, reflux was shown in the cystogram. During the examination the patient had a great desire to urinate, and Kretchmer believed the regurgitation to have been the result of increased tension through straining. Reflux was further shown to occur in 3 cases with disease of the vesical outlet (1, benign hypertrophy of the prostate; 2, contracture of the vesical neck; 3, tuberculosis of bladder, prostate and seminal vesicles) in which, however, cystoscopy had revealed what appeared to be normal ureteral orifices. In concluding the author stated: "It would seem that the increased intravesical pressure may be at least partly responsible in some of the cases for the occurrence of this phenonemon."

Further clinical evidence suggestive of reflux is found in the experiences of Pozzi, Modlinski, Israel, Alksne and probably many others. They described an outpouring of urine from the ureteral stump after nephrectomy and believed in each instance that the occurrence was the result of regurgitation.

These facts together with the repeated clinical phenomena which seem only to be explained on a basis of regurgitation have led the authors to believe that the subject warrants more comprehensive study than it has yet been given. In reviewing the situation we find that regurgitation of vesical contents has already been established as an experimental fact and as a clinical probability, but that little has been offered concerning the conditions under which it occurs and the factors which produce it. With

the purpose to answer if possible some of these questions, the present work has been undertaken.

Our experimental material offered such favorable opportunities for observing the ureter in situ that we yielded to the temptation of studying this organ, the physiology of which is still incompletely understood.

ANATOMY

The anatomy of the ureter will first be reviewed to recall its essential features. Since fundamentally there are no differences in the higher species as far as this structure is concerned, the human ureter will be made the basis of our description.

The ureter is a hollow muscular organ which conveys urine from the kidney to the bladder. Protopopow gives the average length of each ureter as 25 to 30 cm. and the average thickness as 0.5 cm. It is of uniform caliber throughout, save for two points of narrowing which lie at the junction of the ureter with the pelvis and in the intravesical segment. It occupies an extraperitoneal position and extends from the renal pelvis downwards and inwards to the base of the bladder. There is a slight convexity medially, the right lying somewhat farther from the mid-line than does the left. The inferior vena cava lies between the two. The ureters rest on the surface of the psoas major muscles and are covered entirely by peritoneum to which they are attached by areolar connective tissue. The spermatic vessels cross obliquely over the abdominal portion, from above and inward to below and outward. On the left the ureter crosses the distal portion of the common iliac artery and on the right the external iliac in its proximal part, before entering the pelvic cavity. In the male the pelvic portion is crossed at right angles by the vas deferens and after passing beneath the internal iliac vessels and obturator nerve reaches the posterior surface of the bladder.

Microscopically this organ consists of three distinct layers. The outer coat or adventitia consists of connective tissue with some elastic fibers, vessels, nerves, a variable amount of fat and a fibrous capsule which is continuous with the fibrous coat of the bladder. The middle layer is the tunica muscularis which is

0.3 to 0.5 mm. in thickness and represents one-half or more of the diameter of the wall. In spite of some differences of opinion it is generally agreed that the muscle coat consists of three more or less distinct layers. There is the middle circular layer which is of chief importance, a less well defined inner longitudinal layer

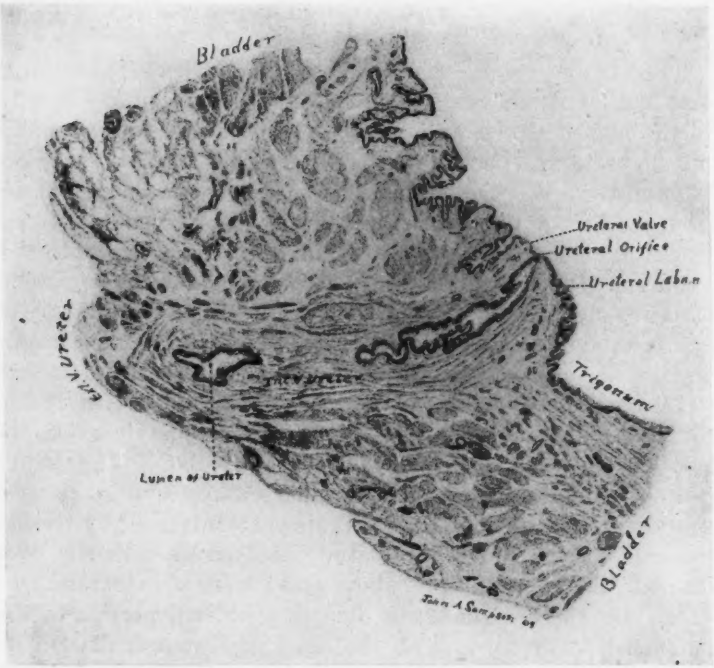

FIG. 1. THE INTRAVESICAL URETER IN AN EMPTY, CONTRACTED HUMAN BLADDER

Drawing by Sampson. The oblique course of the ureter and the ureteral valve are shown. The latter structure becomes more definite as the bladder is distended.

and an even more poorly developed external layer, also longitudinal. The last named layer consists of only isolated bundles (Disse) which are entirely absent in the upper ureter. This orderly arrangement is least well marked near the bladder where the musculature of the ureter is most powerful. Between the

muscle bundles, according to Disse, are spaces filled with connective tissue, equal in volume to the muscle bundles themselves. He describes as a distinct entity the ureteral sheath of Waldeyer which is a layer of longitudinal muscle bundles situated in the adventitia of the distal few centimeters near the bladder. This sheath is divided from the rest of the musculature by connective tissue which also serves to join it to the underlying structures. It is thickest near the bladder and tapers off rather abruptly towards the kidney. On casual inspection this additional muscle layer seems to come out of and be a part of the bladder musculature but Disse has definitely demonstrated its independence from the muscle bundles of the bladder wall.

The mucosa of the ureter presents a stratified epithelium similar to that of the pelvis of the kidney. The surface layer consists of large flattened cells beneath which are several strata of polygonal and globular cells. Capillaries and connective tissue strands enter the epithelium from the submucosa, thus raising it into papillae which are similar to those of the corium of the skin. The submucosa is formed of elastic fibers and connective tissue and blends with the inner longitudinal muscle bundles. It is absent in the distal ureter where the muscle layer reaches the epithelium itself.

The ureteral blood supply comes from the renal, spermatic or ovarian, internal iliac and inferior vesical arteries. The first two supply the pelvis and abdominal portion and the second two the pelvic portion. These vessels reaching the ureter at different levels send out branches along its wall. Smaller arterioles penetrate the substance of the organ at right angles to the surface, again to split into longitudinal branches in the propria. Out of this arises a veritable capillary network, the vessels from all sources anastomosing abundantly. Sampson, for example, by injecting the left renal artery through the open aorta was able to fill without difficulty the entire circulation of the ureter with the injection mass. He also demonstrated that blood supply may come from the aorta and uterine arteries as well as from those mentioned above. The veins begin in the propria and carry their blood to larger vessels at the inner boundary of the muscularis.

These form the venous plexus of the mucosa which is longitudinal but enmeshed by right angled and oblique communicating branches. It drains in turn into a larger plexus visible grossly in the adventitia.

FIG. 2. THE DISTAL URETER IN THE DOG

Low-power photomicrograph. Note again the oblique course through the vesical wall.

The lymphatics of the ureter are incompletely studied. According to the work of Krause and that of Sakata, the lymph capillaries in the propria drain into a larger network lying close to the muscle layer. Efferent vessels pierce the muscle and con-

tinue in the adventitia. Sakata by injection shows these efferent vessels to be divided into deep and superficial groups. Each group from approximately each third of the ureter drains into corresponding lymph nodes along the iliac vessels, the aorta, and the vena cava. There is no direct lymph channel between the

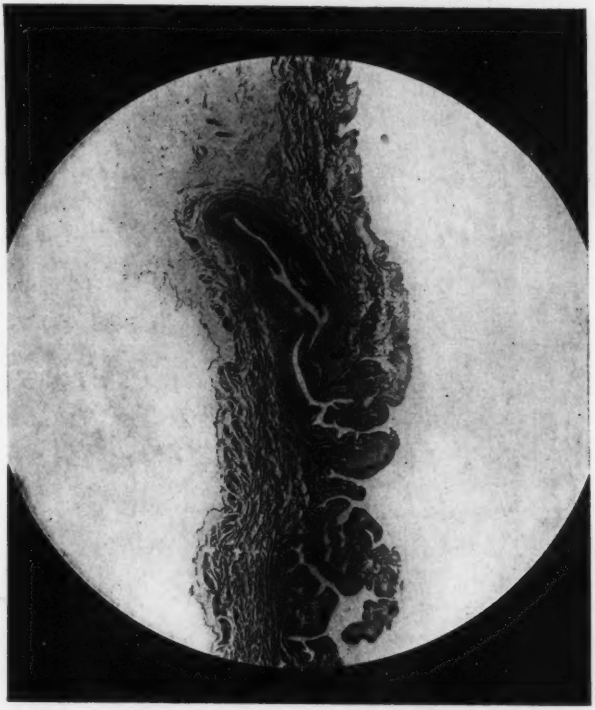

FIG. 3. THE INTRAMURAL PORTION OF THE URETER IN A RABBIT

Low-power photomicrograph. The oblique course through the bladder wall and the resulting valve formation are again clearly shown.

bladder and kidneys, and lymphatic communication if it exists must be either through anastomoses between the lymph capillaries in the different levels of the ureter or through anastomoses between the lymph nodes draining these areas.

The ureter receives its nerve supply from three sources, the renal, the spermatic and the hypogastric plexuses. The renal plexus supplies the pelvis and the upper half of the abdominal portion; the spermatic supplies the lower half of the abdominal portion; and the hypogastric plexus, the pelvic segment. There are both myelinated and non-myelinated fibers entering with the blood vessels to form a ground-plexus in the adventitia. Numerous ganglia occur in this plexus, the larger ones near the extremities of the organ and smaller ones in the mid-ureter. Out of the ground-plexus, branches to the muscularis arise, but whether or not plexuses and ganglia exist in this layer has not definitely been determined. Some authors have found them (Maier); others (Disselhorst, Engelmann) have not. Disse has observed small ganglia between the muscle bundles, but never in the mucosa. Fine nerve fibers have been noted, however, extending into the mucosa, and sometimes even reaching the epithelium.

It was Disse who undertook to establish the facts concerning the anatomy at the uretero-vesical junction. The ureter does not lose its identity but remains a separate structure with only its mucosa blending with the bladder, at the level of the orifice. Because it meets and passes through the vesical wall obliquely the ureter ends as though cut off obliquely with a shorter anterior and a longer posterior wall. The posterior wall blends uninterruptedly with the bladder mucosa but the upper wall forms a fold which embraces the orifice and is called the ureteral valve (figs. 1, 2 and 3). The intramural portion of the ureter has muscle bundles beginning at and even penetrating the propria. All these bundles are directed longitudinally, that is, parallel to the axis of the ureteral lumen. They are separated from the bladder musculature by connective tissue, no communication existing between the two, and they end in the bladder mucosa. Those of the upper wall end in the valve and those in the lower wall lose themselves in the immediate neighborhood of the orifice. Disse concludes that while in a dead subject filling of the bladder would mechanically close the orifice by compressing the valve, this would not necessarily be true in the case of active musculature where contraction of the intramural ureter might hold the lumen open against intravesical pressure.

PHARMACOLOGY

Most of the studies concerning the effects of drugs on the ureter have been directed toward the solution of the puzzling problem of its innervation. And the answer to this problem pharmacologically has been more definite and satisfactory than the anatomical and physiological efforts.

Adrenalin and *ergotoxin* have been usually chosen to demonstrate the presence of sympathetic fibers. Roth, Macht and Penfield working with excised rings of ureter, and Satani using a similar preparation as well as making observations in situ, have all shown that adrenalin increases the rate, tone and amplitude of ureteral peristalsis. Roth noted no variations in the effect of adrenalin on different parts of the ureter, but Satani found the greatest change in the upper segment, the response decreasing progressively towards the bladder. *Ergotoxin* also increases peristaltic activity in the ureter as demonstrated by both Satani and Macht. The latter has shown, however, that after initial stimulation slowing and relaxation follows, and that if adrenalin is now added greater relaxation occurs. He considers this further proof of the presence of sympathetic motor fibers, for ergotoxin inhibits the motor effect of adrenalin but does not interfere with its inhibitory effect.

Pilocarpin and *physostigmin* have been used to study the presence of parasympathetic nerve supply. Roth, Satani, Macht and Penfield have used pilocarpin and agree that it stimulates activity, although Penfield and Roth feel that this effect is only slight. Macht and Satani working with physostigmin, on both the excised ureter and the organ in situ, have shown that definite stimulation is produced by this drug. The latter found that the greatest effect of pilocarpin and physostigmin may be observed in the bladder segment, with gradual diminution towards the pelvis. There is thus sufficient evidence that motor nerve supply to the ureter comes from both the sympathetic and the parasympathetic systems. Moreover, in accordance with the work of Satani the sympathetic sends most of its supply to the pelvis segment, while the parasympathetic system exerts its greatest influence in the distal portion. The middle segment of the ureter is equally supplied by both.

Atropin. Roth found his studies with this drug unsatisfactory, and Penfield could demonstrate only a slight amount of depression following its use. Protopopow, Macht and Satani, however, have shown definitely an initial stimulation followed gradually by cessation of motion. Thus we are furnished with another proof of the presence of motor fibers from the parasympathetic system.

Nicotin. Most workers have shown this drug in small doses first to stimulate and then to inhibit ureteral activity, while large doses immediately paralyze the organ. These facts prove, of course, the presence of ganglion cells. Satani, who studied the effect of nicotin on segments taken from each third of the ureter obtained the same result in every instance.

The above drugs have been studied by most of those interested in the pharmacology of the ureter. A few isolated observations have been made in addition. Roth, for example, found that procain and cocain stimulate the activity of excised segments. He also showed that apocodein has about the same effect as ergotoxin. Satani, searching for additional information concerning the origin of peristalsis, perfused ureters with solutions of uric acid and urea and found both of them to stimulate activity. Macht, working on the rate of absorption from the urinary tract, showed that aconitin, cocain, apomorphin and potassium cyanid are easily absorbed through the walls of the ureter and pelvis. A crystal of barium chlorid placed on the surface of the ureter produces a constriction ring from which peristaltic and antiperistaltic waves arise, as demonstrated by Penfield, Wislocki and O'Conor, and ourselves. An increase of normal peristalsis may be observed, also, when the drug is administered intravenously. Protopopow showed that diuretin has no effect upon the ureter. He found also that caffein in small doses accelerates and in large doses diminishes ureteral activity.

PHYSIOLOGY

The ureter is not simply a passive conductor of the urine, but an active organ, the function of which is to transport the secretions of the kidney to the urinary bladder. This it accomplishes

through rhythmic peristaltic contractions. Careful work has been done on the physiology of this organ by numerous earlier investigators. Notable among them was Engelmann in 1869. For fundamental observations his studies have not been surpassed. He performed his experiments on the ureters of rabbits, in situ, and described the peristaltic waves as consisting of (1) distention with urine, (2) a slight rise of the ureter towards the kidney, (3) contraction downwards, and (4) relaxation; with an accompanying change in color from pink to white to pink again due to the constriction and relaxation of the blood-vessels in the ureteral wall. He found the average speed of the waves to be from 20 to 30 mm. per second and the rate of contraction from 6 to 3 per minute. No antiperistalsis was noted normally.

Pinching the ureter at any point caused waves of equal speed in both directions from the point of stimulation. Cooling depressed, and warming restored irritability. Disturbed circulation also produced depression. All these factors affected not only irritability but in varying degrees the conductivity and contractility as well. Engelmann thought, further, that there was a definite refractory period during which stimulation was ineffective, at least 10 seconds between waves being necessary before complete rest could occur. He felt that in life, smooth muscle is a syncytium and that contractions are transmitted by molecular activity without the interrelation of nerves. The origin of the contraction wave he ascribed to an inherent quality in the musculature, though this may be affected by the increase or decrease of fluid in the lumen or by stimulation from the chemical composition of the fluid itself. Engelmann suggested that the explanation for the pelvis origin of the waves lay in more favorable conditions for irritability in that region, such as better blood supply. Thus this worker foreshadowed more than fifty years ago, Child's modern theory of metabolic gradients.

Protopopow (1897) divided the peristaltic wave into a systole and a diastole. He reviewed the opinions of various authors on the origin of the contractions. Some of them felt that they are altogether dependent upon the stimulation of the urine, others believed them to be under the control of the central or peripheral

nervous system. Still others thought that they occur as the result of an energy inherent in the ureteral musculature. From his own series of experiments he concluded that: (1) Asphyxia stimulates peristaltic activity. (2) Closure of the renal artery and cessation of secretion causes temporary decrease in the frequency of waves. (3) Anemia of the abdominal organs by closure of the aorta above the level of the renal vessels results in markedly diminished ureteral activity. (4) Increasing the quantity of fluid in the ureter produces greater peristaltic efforts. (5) Cessation of secretion by separating the kidney from all its proximal attachments slows activity temporarily, but tying the ureter at the pelvis level results in depression followed by complete inactivity. Protopopow believed this result to be due not only to the exclusion of urine but also to the blocking of the nerve supply from above. He also brought forth some evidence to show that the anastomosis between the inferior mesenteric ganglion fibers and the hypogastric plexus, gives off motor twigs to the ureters. Cutting the major splanchnic, he found, depresses ureteral activity and stimulating its peripheral stump increases it. The latter effect is not observed if the ureter is tied at the pelvis level.

Sokoloff and Luchsinger (1881) worked on fresh excised ureters which they filled with fluid at varying gravity pressures and concluded that within limits, the greater the stretching of the ureteral wall the more frequent and the stronger will be the contractions.

Lewin and Goldschmidt (1893) believed urine in the ureter to be the stimulus to contraction and denied a central nervous system control. They found that pressure on the kidney produced peristaltic waves and explained this by saying that such pressure forced urine into the ureter from the kidney pelvis. In the same way they felt that fluid forced into the ureter from the bladder produces waves in the opposite direction.

Lina Stern (1903) showed by graphic records from excised ureters the effects of changes in temperature upon peristalsis, and proved that lowering the temperature slows the activity, while warming, up to certain limits, increases contraction. Heating beyond that limit causes caloric death.

Sampson (1903) also considered fluid pressure within the ureter as the chief stimulus to contraction. He felt that such other factors as gravity, contraction of the diaphragm and abdominal muscles, intestinal peristalsis and arterial pulsation also aid in the propulsion of the urine downward. He demonstrated in the dog that bladder distention increases the rate of ureteral activity. He denied the existence of antiperistalsis in the ureters of dogs and humans.

Henderson (1905) again showed that pressure within the ureter increases the rate of peristalsis within certain limits. Contractions disappear with pressures of 26 to 32 mm. Hg., in dogs, and 8 to 16 mm. Hg in rabbits. He stated that stimulation of the hypogastric and splanchnic nerves will often produce waves in a ureter which seems paralyzed from too much distention. In dogs he demonstrated a rise in intraureteral pressure of 36 mm. Hg with each peristaltic wave. In rabbits the maximum elevation was 12 mm. Hg.

Lucas (1906) studied graphically the activity of the upper, middle and lower thirds of the ureter in dogs, with these organs in situ. He showed the characteristic activity of the pelvis to be a fine, rapid oscillation. The upper portion of the ureter presents similar oscillatory movements, but these are a little larger and less frequent than in the pelvis. In the mid-ureter are found relatively infrequent larger waves of peristaltic contraction. Upon these, especially in the presence of fatigue and depressant drugs, may be superimposed the fine oscillations usually confined to the pelvis. In the lower segment contractions are smaller than in the mid-ureter.

Alksne (1907) on the basis of his own work together with that of other investigators, which he carefully reviewed, concludes: (1) The ureter has intrinsic movements depending upon the activity of its nerve cells, but these movements are modified by various external factors such as changes in the temperature, composition of the blood, excretion of urine, pulsation of vessels, etc. (2) Cutting across the ureter for more than one-third of its diameter puts an effective barrier in the path of all waves. Partial obstruction allows only some of the contractions to pass

by the obstructed area. Atony of 1 cm. or more of the length of the ureter acts in a similar manner.

Boulet and Gley (1913) studied fresh human ureters and found that the frequency of contraction of the upper portion is greater than that of the middle and lower segments.

Roth (1917) working with excised ureters, described two types of contraction waves, small ones characteristic of the kidney region and larger ones found in the middle and lower thirds. He believed also that the contractions in the middle and distal ureter are more vigorous than those occurring in the pelvic portion. He found, further, that lowered temperature decreases the rate, tone and amplitude of the peristaltic waves, while raising the temperature, within limits, reverses these effects. He placed the optimum range of temperature for dogs' ureters at 37 to 39°C.

Satani (1919–1920) concludes that "the ureteral movements are produced by various mechanisms such as stimulation of the motor nerves, distention of the lumen and chemical effect of the urine, each of which may alone cause contractions of the ureter or which may coöperate with one another." He adds that the viscosity of the fluid effects peristalsis to a very slight degree, while solid bodies within the ureter cause vigorous tonic contractions.

Penfield (1920) studying particularly ureters dilated as a result of experimental obstruction, demonstrated that the stimulus of freshly secreted urine in the pelvis is not essential for peristalsis. In his opinion the "pacemaker" of the ureter is probably located in the pelvis where the highest rate of contraction exists. He explained the downward course of ureteral waves on the basis of metabolic gradients.

Wislocki and O'Conor (1920) found that the ureter responds to the presence of foreign bodies such as glass beads or ureteral catheters, by increased peristalsis and never by any antiperistaltic activity.

Our own work on the physiology of the ureter was incidental to our study of regurgitation. We have nevertheless, through the course of a long series of experiments, been able to confirm many

previous observations, and to correct erroneous conclusions in some instances. Since most of our physiological studies were made in the earlier experiments in which rabbits were used, much of our information has been gained from these animals.

Waves of peristalsis vary in frequency in the normal ureter, occurring from 1 to 5 times per minute. Because of the greater amplitude of the contractions in the mid-ureter they are best observed at that level. There occurs in sequence at a given point, first a wave of dilatation (the column of urine that is being propelled bladderwards), followed closely by the wave of contraction (the propelling power) which seems to carry the ureter downward for a short distance; and lastly an upward relaxation which restores the given point to its position of quiescence. These events are less easily distinguished in the upper ureter where only undulatory movements may be discerned. The amplitude of the contractions, as indeed their frequency and speed, vary in different subjects and in the same subject, with the degree of irritability and conductivity of the ureteral musculature at the time of observation. In general the speed of the peristaltic waves is greatest in the upper third of the ureter and least in the lower third. Average figures in about 20 experiments were 18.3 mm. per second for the upper third, 15.4 mm. for the middle third and 13.3 mm. for the distal segment.

In one series of experiments partial ureteral obstruction of varying degree was produced with aluminum or elastic bands, and complete obstruction with silk ties. Examination of these animals was made some weeks after operation, allowing thus an opportunity for the effects of the obstruction to become established. The modification of normal anatomy and physiology is worthy of note. Slight partial obstruction resulted in mild hypertrophy without dilatation, and peristalsis remained practically unaffected, the waves continuing through the length of the ureter, unimpeded by the band. In those cases where obstruction was almost complete the ureter above the obstruction was much hypertrophied and considerably dilated. Peristalsis, however, continued uninterruptedly down the ureter. In the hypertrophied, dilated portion the component parts of the waves were

less easily distinguishable, probably because of the fact that constriction did not result in complete temporary obliteration of the lumen as in an undisturbed ureter. The segment below the band appeared to be normal, but the phase of dilatation of the wave seemed to precede the constriction by a longer interval than commonly observed. This we believe was due to the fact that the column of urine forced out of the dilated portion was longer than usual. The frequency of contraction on the obstructed side varied considerably, but on the whole averaged a little less than on the normal side. The speed of the waves also varied widely but in general the less the obstruction, the more nearly normal relative speeds existed in the segments above and below the band. In the much hypertrophied and dilated upper segments the speed was definitely less than in the lower unobstructed ones.

In those cases where complete obstruction existed there was marked dilatation with thinning of the ureter and pelvis above the obstruction, increase in length as shown by tortuosity, and haustration resembling that seen in the large bowel. These changes were in sharp contrast to the incompletely obstructed ureter in which the wall was thickened and the contour quite uniform. Below the tie the organ seemed atrophied. The latter appearance was probably due to the fact that this segment was usually empty of urine and collapsed. In such ureters peristalsis was seldom noted. Those waves that were seen usually consisted of shallow ripples that did not advance much beyond their point of origin in the pelvis.

In 1 case (experiment 39) in which a left nephrectomy had been performed ten days before experiment, the ureteral stump was found to be in motion when exposed to view. Upon analysis this was shown to be normal peristaltic activity, without, of course, the presence of urine. Later, reflux occurred into the stump and peristalsis was stimulated as in a normal ureter.

In only 3 cases of all our experiments did we observe anything suggesting reverse peristalsis not artificially produced. In 1 previously normal ureter following regurgitation there occurred in the bladder segment a brief series of constrictions which

extended for a short distance upwards and suggested possible antiperistalsis. In another case in the lower segment of a completely obstructed ureter somewhat similar changes were observed following reflux. In the last of the 3, a case of partial ureteral obstruction, we saw two waves of reverse peristalsis, one from the obstructing band to the pelvis, the other beginning at the bladder and also reaching the kidney. It may likewise be mentioned in passing that not only did antiperistalsis fail to appear as a result of regurgitation in practically all of our cases, but that direct injection of fluid into the ureter from below upwards resulted merely in waves of contraction beginning in the pelvis and proceeding in the normal direction, the point of puncture for injection seeming to act as an area of block beyond which waves did not descend.

On 2 occasions in which the ureter was dilated and the bladder very full there seemed to be dissociation of the normal ureteral rhythm to such an extent that two separate parts of the ureter contracted independently with varying time intervals. The two segments seemed to be obedient to two separate "pacemakers," as though the dilatation of the ureter, or the increased intravesical pressure, or both, had produced temporary interruption of the normal conductivity. In 1 of these cases the ureter was filled with urine, in the other it had just become distended with regurgitant fluid from the bladder.

As has been said, the normal ureter is subject to the changes in irritability, contractility and conductivity characteristic of other smooth muscle organs. We have observed the effects of a variety of external influences. In the few cases in which observations were made under primary anesthesia, struggling of the animal had no apparent effect upon ureteral activity. Prolonged deep anesthesia, other factors being constant, seemed to be followed by depression. Chilling of the preparation inevitably slowed the contractions while rewarming restored the normal rate. Barium chlorid crystals applied to the surface of the ureter produce constriction rings from which contraction waves go out in both directions. Depending upon the state of irritability of the ureteral musculature these waves vary from barely perceptible ripples to

definite peristaltic movements. The areas of constriction persist for considerable time as areas of block beyond which descending waves do not pass. Given intravenously in proper dosage this same drug stimulates normal ureteral activity. Mechanical stimulation by pinching or cutting acts in the same manner as does the local application of barium chlorid crystals. In dogs we found that gentle rubbing of the surface with gauze produced peristalsis in an otherwise inactive ureter.

We have had particular opportunity to observe the effect of bladder distention upon ureteral activity. When the bladder begins to fill there is a speeding up of peristalsis. With greater degrees of retention, and increased intravesical pressure, the ureter acts more slowly, but more vigorously, its greater tone being evidenced by blanching throughout its whole extent. Where intravesical pressure has reached a relatively high level the ureter again speeds up in frequency but becomes dilated and increasingly ineffective in emptying its load. Finally fatigued, and overdistended, its waves become mere ripples and eventually cease. In other words, there has developed a ureteral retention which is inevitably associated with bladder retention—a fact too little regarded in clinical condiderations, and one which gives definite significance to the term "back pressure" in prostatic obstruction.

The immediate effect of regurgitation on the ureter, as will be seen later, is a sudden increase in rate and vigor of peristaltic activity as if in an effort to expel the invading fluid. There are two possible results of this conflict: either the increased activity succeeds in eventually forcing out the bladder fluid so that the ureter returns to its normal peristalsis; or the waves become increasingly inefficient until the organ is finally distended and motionless, its lumen filled as in our experiments, with colored vesical contents. We have practically never seen antiperistalsis resulting as a sequence of regurgitation.

Keeping still in mind the question of prostatic "back pressure" it seems to us of especial interest that after regurgitation the bladder pressure is transmitted directly to the renal pelvis, the two structures being in open communication. This we demonstrated

in 6 cases in which we measured the intrapelvic pressure by means of a water manometer. The latter was attached to a small cannula passed into the pelvis through the kidney parenchyma. The average bladder pressure at the time of regurgitation in these cases was 21.8 mm. Hg while the pelvis pressure was 26.9 mm. of water or about 20.7 mm. Hg, the difference not beyond the limits of error. When the vesical tension is reduced, pelvis pressure remains elevated until ureteral contractions produce sufficient emptying to lower it. No reduction in pelvis pressure occurs if the ureters remain inactive. In experiment 121, for example, reflux occurred with a bladder pressure of 22 mm. Hg. Pressure in the renal pelvis promptly rose to the same level. Upon emptying the bladder the ureteral orifice apparently closed and no waves occurred in the ureter, for pelvis pressure still remained 22 mm. Hg.

METHODS

The technique which was used throughout our work was based upon certain fundamental procedures which we will outline in detail.

In the series under discussion the experiments were carried out upon male rabbits. In most instances the animals were anesthetized with urethane (1 gram per kilogram of body weight) given by means of a stomach tube, and morphia ($\frac{1}{8}$ grain) given subcutaneously. In order to exclude the possible influence of urethane, paraldehyd (1 gram per kilogram) was used in its stead with sufficient frequency, for control purposes. In some instances the urethane or the paraldehyd was used alone without morphin. In a large number of cases, a small amount of ether was given in addition, for complete anesthesia during the early stages of the preparation. Occasionally the urethane was given rectally. After an interval, usually of thirty minutes, allowed for satisfactory anesthesia, the animal was placed in a warm chamber in which body temperature was maintained by a thermostat and equalized throughout by means of a small electric fan.

A mid-line incision opened the peritoneum from ensiform to pubes. The rectum was usually doubly tied and cut and the intestines were reflected upwards and to one side where they were

enclosed in a towel moistened with warm physiological salt solution. For this procedure it was only necessary in addition to dividing the mesocolon, to ligate and cut the inferior mesenteric artery. The vessel was divided peripheral to the inferior mesentery ganglion and its fibers. In this way the bladder and the ureters throughout their extent were exposed to view. The tissues were kept moistened with physiological salt solution at body temperature. To exclude the possible effects of shock a few experiments were performed in which the rectum was not cut across, the intestines being merely turned aside to expose one ureter, and we found this preparation no more favorable for the production of regurgitation than the other. In numerous cases the abdomen was not opened at all until the close of the experiment.

The bladder was now emptied of its contents, varying in amount from a few cubic centimeters to occasionally 100 cc. or even more. The emptying was accomplished with a small, soft rubber catheter passed through the urethra. The catheterization of a male rabbit is very easily performed and while we usually made use of size no. 11 French, larger sizes could easily be passed. We will repeat the admonition of Courtade and Guyon, however, that the procedure must be gently and slowly performed lest the catheter tip leave the urethra and enter the seminal vesicles. The opening through which these structures communicate is, in the rabbit, unusually large. In many instances we catheterized the animal soon after giving the anesthetic, thus insuring a relatively empty bladder at the time of opening the abdomen. When all preparations were complete we usually allowed an interval varying from fifteen to forty-five minutes before actually beginning bladder filling. During this period body temperature was reëstablished in the chamber if any slight chilling had occurred. Moreover and perhaps of greater importance, the bladder musculature was given a definite rest period in the empty state.

From a burette, the maximum hydrostatic pressure of which was about 50 mm. of mercury the solution to be used was slowly introduced through the catheter into the bladder. The fluid in

all cases in this series was physiological salt solution (0.85 per cent) colored with small quantities of 1 per cent aqueous methylene blue or India ink, merely for purposes of increased visibility. A coil of tubing immersed in a water bath and inserted between the burette and the catheter served to maintain body temperature in the solution introduced. The rate of flow into the bladder ranged from 1 to 2 cc. per minute.

In a few cases we filled the bladder through the urethral catheter by means of a syringe in order to compare our method with that used by most of the earlier investigators. While the final results were not essentially different, we found this method less convenient and less easily controlled. In a few other cases we attempted filling with a syringe, and hypodermic needle inserted directly through the vesical wall. This we found highly unsatisfactory and unreliable. In 1 case we demonstrated that it is easily possible to fill the bladder through one ureter and produce regurgitation upon the other side.

A mercury manometer in open communication with the system made it possible at all times to read intravesical pressure. Filling was continued until positive results were obtained or until such time as further filling would have been beyond physiological limits of distention.

SERIES A: A SERIES OF NORMAL RABBITS, THE BLADDERS OF WHICH WERE FILLED WITH WARM PHYSIOLOGICAL SALT SOLUTION

In this series are included experiments upon 73 male rabbits with a total of 76 bladder fillings. It was our purpose to simulate as closely as possible the normal vesical distention. Body warm physiological saline was slowly introduced and trauma in the preparation of the subject was reduced to a minimum. By these means we were able to secure regurgitation of vesical contents into the ureter in a total of 73.7 per cent of the cases. Most of the failures occurred in the early stages of the work when we were less familiar with the technique of preparation. In the second half of the series we produced regurgitation in 86.8 per cent of the attempts.

A typical experiment proceeded about as follows:

Experiment 29. October 27, 1921. Gray male rabbit; weight 2.4 kgm. Urethane (1 gram per kilogram) by stomach tube and morphin (¼ grain) subcutaneously. Preparation in about three-quarters of an hour, and at this time a small amount of ether was given. The work was done in the thermostat chamber with the atmosphere maintained as nearly as possible at the level of the rabbit's body temperature. Abdomen opened from ensiform to pubes; rectum doubly tied and cut. Inferior mesenteric artery doubly tied and cut. Intestines reflected upward and to the right exposing bladder and both ureters in their full extent. Tissues kept moistened with body warm normal saline. Animal carefully catheterized; very small amount of urine obtained (2 cc.). Rest period of twenty minutes during which bladder contracted down well. It seemed to possess good muscle tone. Fluid prepared and warmed to body temperature (100 cc. physiological salt solution and 5 cc. of 1 per cent aqueous methylene blue). Filling began, with a rate of 1 to 1.5 cc. per minute.

At the beginning of filling, both ureters were acting vigorously, each presenting three peristaltic waves per minutes and each wave obviously accomplishing the transportation of a considerable amount of urine. When 10 cc. had been introduced into the bladder the ureters were still active and the bladder was elongated and apparently resisting distention actively, as shown by its cylindrical form. Rhythmic undulatory contractions of the vesical musculature were observed. Pressure 5 mm. Hg. With 20 cc. the pressure was 9 mm. Hg.; the bladder was quiet and both ureters were active. With 26 cc., a sudden rush of a blue column of fluid from the bladder into the left ureter filling its lumen to the kidney. Similar reflux soon followed on the right. Pressure 18 mm. Hg. Ureteral waves rapidly increased in frequency, now acting 8 to 10 times a minute. At first these waves successfully pushed the blue columns downward. Gradually, however, the contractions grew less effective until finally the ureters, becoming more and more feeble, lay blue and motionless (plate 1).

The bladder was now partially emptied and the pressure thus reduced allowed the ureters to become active so that they succeeded in emptying themselves in about five minutes. The bladder was then refilled and reflux again occurred with 26 cc. of fluid, and a pressure of 16 mm. Hg. Upon allowing the preparation to stand for a brief interval the fatigue of the vesical musculature lowered the tension slightly, but sufficiently

to permit the ureters again to empty. Then the introduction of about 1 cc. of fluid from the burette restored the pressure and once more produced regurgitation.

In this work we have demonstrated conclusively that regurgitation of the vesical contents is an experimental fact. To be sure, as we have previously stated, so much has been shown by earlier workers. There has thus far, however, been no satisfactory explanation of the phenomenon, no complete analysis of the factors by which it is produced. It has been our purpose, therefore, to determine, if possible, the conditions under which reflux occurs; and a careful review of the results of the present "normal" series will be of value. Apart from the general consideration of anesthesia it is convenient to discuss separately the bladder and the ureter and then the interrelationship of these two structures with their bearing upon the phenomenon of regurgitation.

Concerning anesthesia, suffice it to say that nine different combinations were used of urethane, paraldehyd, morphia and ether. Urethane seemed more ideally suited to our purposes. It possesses excellent anesthetic properties, it is not profoundly depressing and it has a mild diuretic effect. In those experiments in which paraldehyd was used, and especially in which in addition the condition of the animal required the use of large amounts of ether, there seemed to exist a certain amount of depression. But as far as could be determined statistically the type of anesthetic, and the fact of anesthesia as such, was of relatively small importance.

Relationship of bladder to regurgitation

It was of interest to observe the varying amounts of urine present in the animals at the start of the preparation. In 53 of the 73 cases the bladders were either empty or contained 10 cc. or less. Eighty-eight per cent of these cases permitted the occurrence of regurgitation, while in those cases in which the bladders contained moderate or large amounts of urine only 44 per cent showed reflux. This relationship of initial bladder content to the final successful result of the experiment became very evident

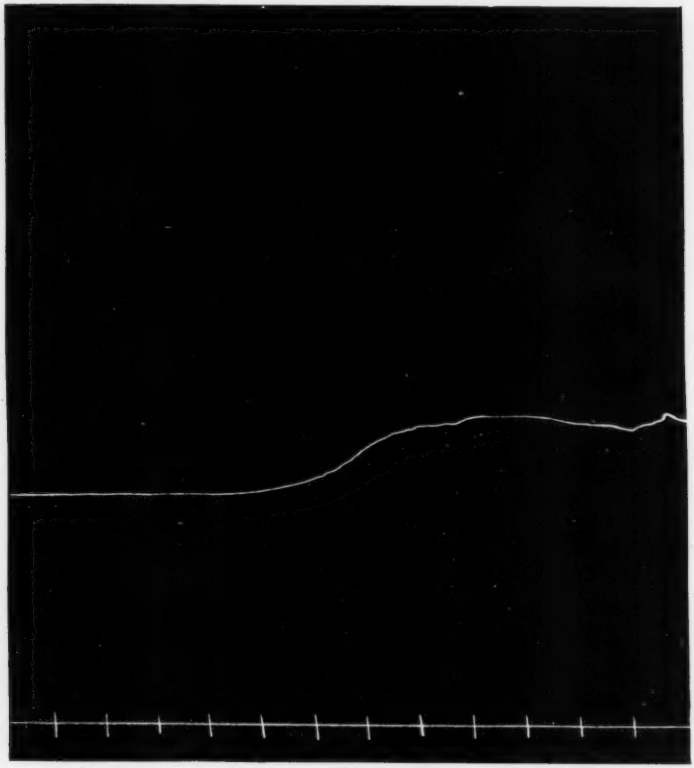

FIG. 4. TRACING OF THE DEVELOPMENT OF INTRAVESICAL PRESSURE IN A GRADUALLY DISTENDED RABBIT BLADDER

Rabbit 172, April 20, 1922. The initial rhythmic contractions were not transmitted to the record. It is in the period of sustained high pressure that reflux occurs. In this case, at the point marked by the arrow, bilateral regurgitation was observed, (23 cc. in the bladder; pressure 29 mm. Hg.).

as the work progressed and we were led frequently to catheterize the animal at the time of the administration of the anesthetic, in order to insure a contracted bladder at the beginning of the experiment, and one which had had a definite period of rest in the

contracted state. From this experience it appears to us that at a given time any given bladder possesses the ability to raise and maintain a definite pressure with a given quantity of fluid, entirely different from the pressure which the same bladder can develop at another time under different conditions.

The vermiform activity of the filling bladder, to which we referred in protocol 29, is caused by rhythmic contractions of the musculature stimulated by gradually increasing distention. As the upper limits of intravesical tension are approached, these rhythmic movements cease to be apparent and in their stead occurs a sustained contraction of the bladder wall upon its contents. It is in this tonic state that pressure within the bladder rapidly rises until such levels are reached as render reflux possible (fig. 4).

In the period of rhythmic activity, the muscle fibers are lengthening as filling proceeds. The intermittent contractions represent a sort of clonic response to the stimulus of stretching or distention. Later, further stretching is continuously resisted, and the state of tonic, sustained contraction is reached. In other words, the bladder at first apparently responds to the gradual filling, isotonically, that is by increasing the length of the muscle fibers without changing the tension (except for the periodic contractions described above). Finally, when a sufficient quantity has been introduced, the response becomes isometric; the fibers maintain the same length and respond to the stretching force by a rapidly increasing tension.

Our experiments demonstrate the fact that reflux is attained most rapidly or with the smallest quantity, in those bladders in which the response tends to be isometric from the start. In some cases tone was so active and the isometric state was reached so soon that intermittent contractions were not observed at all, and in these cases reflux pressure levels were developed with surprisingly small quantities of fluid. In other instances, however, and indeed in the majority of the experiments, a rhythmic activity preceded the final tonic resistance to filling. A third type of bladder occurred, so lacking in tone, that muscular contractions failed to appear at all, or did not get beyond the

rhythmic state. These bladders presented no active resistance to filling and in them the pressure finally engendered was purely a passive, mechanical tension produced because the sac could hold no more. In such cases, regurgitation never occurred.

Rabbit 5. Brown and while male; weight 2.42 kgm. September 26, 1921. Urethane and morphin anesthesia. Usual preparation. Intestines turned aside; no trauma or bleeding. Ureters amply exposed for observation. Moderately full bladder emptied through catheter. Catheter fixed in position by ligature around the penis. Box temperature regulated. Ureters noted to be acting sluggishly at the rate of about one contraction per minute. Filling begun one-half hour after emptying of bladder. Rate about 1 cc. per minute. Bladder seemed toneless in that it filled like a lifeless sac flattened against the posterior body wall upon which it rested. No rhythmic contractions observed. With 40 cc. pressure 5 mm. Hg. With 60 cc., same ureteral activity; pressure 5 mm. Hg. With 80 cc., same ureteral activity; pressure 7 mm. Hg. With 100 cc., left ureter less active; pressure 5 mm. Hg. The 100 cc. were readily introduced into the bladder which seemed quite incapable of active resistance. No regurgitation.

The average quantity of fluid used in bladder filling in this series was 49 cc., and in the second half of the series, 30 cc. These quantities are not excessive in rabbit bladders for we have frequently found much larger quantities of urine in these animals at the time of preparation. We considered that the upper limits of capacity had been reached in a given case when reflux had occurred, or when the quantity introduced had approached the 100 cc. mark; or when evidence of thinning of the vesical wall had occurred. The largest amount of fluid used was 184 cc. in experiment 12 and the smallest quantity was 8 cc. in experiment 119. This wide variation is striking when it is considered that animals of fairly uniform size and weight were used. It is also noteworthy that in no. 12 (184 cc.) the upper limit of pressure was 12 mm. Hg while in no. 119 (12 cc.) a pressure of 13 mm. of Hg was reached. This demonstrates conclusively that intravesical tension does not depend primarily upon the amount of fluid in the bladder but rather upon the tone of the bladder musculature. In the 2 experiments mentioned above, reflux occurred with the small quantity and did not occur with the large.

The amount of fluid necessary to produce regurgitation ranged within the same wide limits. The smallest quantity giving reflux, in this series was 7 cc. while the largest quantity was 145 cc. The average quantity giving regurgitation was 34.8 cc. and in the second half of the series, with better preparations, 23.2 cc.

The intravesical pressure at the time of reflux did not vary, markedly. The average for the whole series was 13.6 mm. of mercury; for the first half of the group, 14.8 mm.; for the second half, 12.3 mm. of mercury. The more active tone of the bladders in the second half of the series is again shown by the fact that practically the same pressure levels were reached in spite of the much smaller quantities used. It is certain that active pressure is the primary consideration, while the quantity used to produce it is of relatively small consequence. The highest pressure reading that we have recorded, with which reflux occurred, was 50 mm. of mercury (experiment 32). This was produced, however, with 130 cc. of fluid. The lowest pressure of reflux was 4 mm., reached with 11 cc. of fluid (experiment 91).

Realizing the importance of bladder tone in regurgitation we attempted to improve this factor in a few of the more or less toneless bladders. Handling the organ or exposing it to chilling produced slight increase in the tone of the vesical musculature but this was never sufficient to cause appreciable increase in tension. Asphyxia gave no change in intravesical pressure except that which could easily be explained by the struggles of the animal; certainly no sustained increase occurred. Direct electrical stimulation of the bladder resulted in local contraction without general effect. Electrical stimulation of the femoral nerve was followed by rhythmic movements without demonstrable alteration in pressure. Squeezing the bladder with the fingers and passively raising its pressure had no effect in producing regurgitation. In order to control the possible influence of dividing the abdominal wall we allowed the abdomen to remain intact in many cases and found that there was no difference in the final outcome of the experiments. This we expected in view of the fact that the contraction of the abdominal muscles can add only passively to bladder pressure.

Stimulated apparently by the distending bladder we have observed on numerous occasions spasms of the genitalia with rhythmic contractions of the pelvic floor, resulting in intermittent rises of intravesical tension. This pressure being unsustained, seldom resulted in regurgitation, but being active pressure—that is pressure to which active contraction of the bladder musculature contributed—it is conceivable that if this spasm should occur at a propitious moment the added increment of pressure might produce reflux.

With regard to the condition of the bladder at the close of the experiment, our figures show that 52 cases (93 per cent) in which regurgitation occurred presented perfectly intact bladders at the time of reflux. In three experiments in which regurgitation took place, there was evidence of imminent rupture as shown by areas of thinning of the vesical wall or seepage through it of colored fluid. The quantities used in filling in these cases, were 85, 90 and 145 cc. Of the cases in which we did not obtain reflux 20 per cent showed some damage of the bladder wall. There is ample evidence in this record that the phenomenon which we are studying does not require for its production excessive quantities or pressures. It seems reasonable, further, to conclude—both from the fact that so high a percentage of injuries to the bladder wall occurred in the unsuccessful experiments and also that in those cases of reflux in which the bladders were damaged the quantities used were far above the average—that damage occurred more frequently in the toneless organs, incapable of regurgitation. This situation finds analogy in the repeated and futile efforts of other workers to produce reflux by over-distention of the cadaver bladder. Such attempts, as is well known, have invariably resulted in rupture, without the occurrence of regurgitation.

Our usual procedure in these experiments was to secure the urethral catheter by a ligature around the penis, but in several cases this tie was omitted and contraction of the bladder neck was depended upon to prevent leakage of fluid around the tube. In a majority of these cases a leak of colored solution occurred before reflux pressure levels were reached. But in some instances

bladder tension was raised to the point of ureteral reflux without relaxation of the vesical sphincter.

Experiment 17D. Male rabbit; 1.9 kgm. February 2, 1922. Usual preparation of animal. Ureters both doubly tied and cut near kidney pelvis (for purposes of experiments then in progress). Urethra easily catheterized; *not tied.* Bladder contained only a few cubic centimeters and seemed to possess good tone. Filling started about one hour after anesthesia. With 6 cc., complete regurgitation on the right, followed quickly by regurgitation on the left side. Pressure 20 mm. Hg. Bladder sphincter did not give way. Preparation allowed to stand for one hour; sphincter still unrelaxed.

This point seems to us of significance, for a clinical analogy would be found in a patient in whom reflux occurred as a result of either voluntary or spasmodic sphincter contraction without the presence of any other mechanical obstruction.

SERIES B: RABBITS IN WHICH THE URETERS HAD BEEN DISTURBED IN PREVIOUS OPERATIONS

This group consisted of 42 bladder fillings in 38 male rabbits. In each case the normal conditions existing in one or both ureters had been disturbed in a previous operation, performed either some weeks before or immediately preceding the experiment. In 15 animals (group 1) the operation had produced obstruction in the left ureter, varying in degree from slight to absolute obliteration of the lumen, by means of aluminum or elastic bands and silk ligatures. In 18 cases (group 2) the ureters were doubly tied with silk and cut across, just before the beginning of the experiment. In 5 rabbits (group 3) the left kidney and ureter were dissected free from all nerve and blood supply down to the bladder wall itself in order to render that side entirely motionless. Otherwise, the conditions of experimentation were essentially the same as in series A.

Taking the series as a whole, we succeeded in producing reflux in 33 of the 42 attempts or in 78.7 per cent of the cases. Of the 5 in which the left side had been rendered motionless, regurgitation occurred in 4 and in all of these the reflux was bilateral, the

left ureter being the first invaded in 2 instances. Of the 18 cases in which the ureters were doubly tied and cut, reflux was obtained in 12; and of the 19 vesical fillings in the remaining group (group 1), seventeen or 89.4 per cent resulted in regurgitation. In only 3 of these was reflux unilateral, occurring twice in the normal side and once in the abnormal ureter.

The quantity of fluid necessary to produce regurgitation averaged 35.8 cc. in this series as compared with 46 cc. in series A; and the average pressure was 26.3 mm. Hg as compared with 13.6 mm. Hg in series A. This difference in pressure in the two groups which at first seems to imply that disturbed ureters offer greater resistance to reflux, loses much of its significance when it is recalled that in more than half of the present series normal ureters existed on the right side as controls. And these permitted regurgitation at no lower pressure levels than did the others. The fact that higher pressures were raised in this series, with lower quantities, simply means that bladders of better tone were encountered. The further fact that with these better bladders higher pressure levels seemed necessary for regurgitation in both disturbed and undisturbed ureters is less readily understood. It may be due to the influence of operative interference or may appear simply as a result of the less flexible statistics of a much smaller group. The latter seems to us more probable.

Experiment 47. Black male rabbit; 8.1 kgm. October 13, 1921. Ether anesthesia. Aseptic operation in which an aluminum band was placed about the left mid-ureter for partial constriction of its lumen. Abdomen closed. Good recovery.

November 7, 1921 (twenty-five days after operation), animal found to be in excellent condition. Urethane anesthesia (1 gram per kilogram) with morphin ($\frac{1}{8}$ grain) subcutaneously. Bladder emptied by catheter, of a few cubic centimeters of urine. Usual preparation started about three-quarters of an hour after urethane. Bladder found empty and well contracted. Right ureter normal and contracting vigorously. Left ureter thickened and markedly dilated above the obstruction. Very little scar tissue about the band. Below the band the ureter appeared normal. Vigorous peristalsis was present, the contractions beginning in the pelvis and travelling down the dilated portion, by the band, and onward to the bladder. The waves were ineffective, however,

in emptying the hydroureter. In fact the activity was of brief duration and the ureter soon became motionless.

The bladder responded to the distending fluid with rhythmic movements. With 10 cc. the left ureter again began to contract. What appeared to be a wave of antiperistalsis was seen to begin at the bladder and travel in an upward direction to the pelvis. In behavior and speed it resembled a normal wave.[2] With 17 cc. the bladder gave evidence of good tone; rhythmic contractions ceased; pressure: 8 to 10 mm. Hg. Filling continued. At 30 cc. bladder pressure was 36 mm. Hg. Reflux suddenly occurred on the left side, the colored fluid passing rapidly to the region of the band. At the same time regurgitation was observed on the right. The left ureter became distended and motionless as gradually the black column diffused through its whole lumen to the kidney.

The lowest pressure at which regurgitation occurred in series B was 9 mm. Hg and the highest, 50 mm. Hg. The quantities ranged from 6 to 171 cc. In 29 of the 38 animals (76 per cent), the bladders were either empty or contained small amounts of urine at the beginning of the preparation, a fact which as was explained has definite bearing upon the large percentage of cases in which reflux was obtained. In 9 cases the bladder was not entirely intact at the close of the experiment, but 6 of these were not in the regurgitation group. In spite of the abnormal ureters in series B, it is apparent that reflux occurred certainly as frequently as with normal structures. Indeed the percentage of successful experiments in this group is higher than in series A, a result which may be ascribed to the more actively tonic bladders.

Relationship of the ureter to regurgitation

The degree of activity of the ureters, in sharp contrast to the beliefs of other workers, seems to exert relatively little influence upon the occurrence of regurgitation. Indeed, as we have shown, complete absence of ureteral activity does not preclude the possibility of the phenomenon.

The occurrence of antiperistalsis in the normal intact ureter either before or after or at the time of reflux was not observed by

[2] This is the only reasonably certain example of antiperistalsis seen in all our experiments.

us, with the possible exception of a single instance. Forewarned by the emphasis given it by many other students of the subject we zealously watched for its appearance throughout this series, and throughout several subsequent ones to be reported at a later date. Yet at no time could the activity of the ureter be interpreted as peristaltic movement toward the kidney. In a normally acting ureter the contractions increase in frequency as intravesical pressure rises, but always the waves are coursing toward the bladder. Then when reflux occurs, the force behind the regurgitant column may push its way through the oncoming waves of peristalsis and fill the whole ureter to the pelvis; or, a downward directed wave of contraction may meet the invading column more effectively and carry it bladderwards. Frequently the contraction is only partly successful, and after carrying the column downward for some distance it appears to give way slightly and to allow an opening in the lumen of the ureter sufficient to permit the upward directed fluid from the bladder to "slip under" the wave and continue its ascent. This movement of the colored fluid up and down, unless carefully analyzed, may easily be interpreted as an interplay of peristaltic and antiperistaltic waves.

The type of reflux seems in a general way to have varied with differences of peristaltic activity. For example, the rapid, sudden "quicksilver" ascent of the colored column to the pelvis was observed most frequently in the vigorously contracting ureters. The gradual type of reflux, in which the color diffused slowly along the length of the ureter was usually associated with those ureters the contractions of which were enfeebled. We have also noted that the "sudden" reflux occurred with much lower intravesical pressure than did the gradual type.

Neither ureter proved to be more susceptible to regurgitation than the other. In fact, of the 56 positive cases in series A, 44 or 78.6 per cent were bilateral. Where reflux occurred upon one side only, the two ureters were invaded with equal frequency.

The degree of activity of the ureters at the beginning of the preparation, before the start of bladder filling, seemed to have no bearing on the final outcome of the experiment, a fact which was brought out most strikingly in series B.

Inter-relationship of ureter and bladder in the phenomenon of regurgitation

We have seen that the occurrence of regurgitation depends in the largest measure upon the presence of bladder tone, and have also noted that the condition of the ureters is of minor importance. We feel nevertheless that there is an optimum time and condition in cases with tonic bladders and vigorously acting ureters, when reflux is most readily produced. We first became interested in this point by noticing that in such cases when the bladder pressure had become relatively high, the column of urine carried downward by the peristaltic efforts of the distended ureter, seemed to fluctuate or waver rapidly back and forth at the bladder level until it was picked up and carried into the bladder by the next contraction. Furthermore, we frequently noted gradual regurgitation beginning soon after the "waver" was first observed, the colored column from the bladder then taking part in the fluctuation until it had diffused throughout the entire length of the ureter and rendered reflux complete. Upon analysis of these events we concluded that in the cases where this phenomenon took place, regurgitation was facilitated by an interplay of forces existing in both ureter and bladder. When the peristaltic waves of the ureter are competent, the contraction phase causes a complete obliteration of the ureteral lumen from above downward. As this obliteration descends, a column of urine of varying length precedes it. Upon arriving near the uretero-vesical junction, this fluid column forces open the orifice which remains open until the contraction wave itself has completed its course. Now as previously described, the increasing tension in the bladder causes the ureters to dilate, and sooner or later the peristaltic waves become less effective, especially in the distal segment. Our explanation of the "waver" and regurgitation under these conditions, is that a contraction gives way in the lower ureter after the orifice is opened. The obliteration of the ureteral lumen being now incomplete, the urine column plus bladder fluid starts backward toward the kidney only to be met by the next oncoming, still competent wave. This new wave itself becomes incompetent near the

bladder and thus the whole cycle is repeated until regurgitation fills the ureter.

While this theory explains reflux in some instances it obviously cannot be accepted as the only explanation or even as the most important one. For as we have shown regurgitation is produced just as readily with ureters which are entirely inactive and in those which are empty of urine. The chief factor in the production of this phenomenon lies in the bladder, for the one indispensable requisite without which we have never been able to obtain reflux, is active tone of the vesical musculature. We believe that tonic contraction of the bladder wall against the distending fluid, particularly in the presence of vesical-neck obstruction, is able to open the ureteral orifice sufficiently to permit regurgitation to occur.

SERIES C: RELATION OF URINARY RETENTION TO REGURGITATION

Rather incidentally in the course of other experiments we attempted in a few instances to produce regurgitation by means of prolonged urinary retention. The method was as follows. After emptying the rabbit's bladder aseptically, from 10 to 20 cc. of warm concentrated India ink or methylene blue were introduced. The catheter was then removed, and under procain anesthesia, the end of the penis was transfixed and tied. The animal was given morphin and returned to the cage. Fluids were supplied by mouth and intravenously, to insure active diuresis. In 2 cases this procedure was varied somewhat, as illustrated in the following protocol. After periods varying from six to twenty-five hours, laparotomy was performed under anesthesia. Of the 7 animals so studied, regurgitation was found to be present in 1 at the time of examination. In another case partial reflux occurred during the inspection of the bladder, without the addition of more fluid.

Experiment 197. Male rabbit, 1.8 kgm. July 11, 1922. Ether anesthesia. Aseptic technique. Left nephrectomy through a flank incision, leaving a ureteral fistula.

July 14, 1922 (after three days). Operative wound practically healed. Mouth of fistula not readily identified. Bladder emptied and 10 cc. of 1 per cent methylene blue introduced. Penis tied (procain). Morphia $\frac{1}{6}$ grain subcutaneously and 24 cc. warm physiological saline intravenously.

July 15, 1922 (twenty-four hours later). No stain about fistula. Bladder palpable through abdominal wall as large, firm mass. Chloralose anaesthesia. Laparotomy. Bladder large and tense (130 cc.), and perfectly intact. Complete regurgitation in right ureter.

The above series is too small to warrant general conclusions, but it demonstrates that regurgitation can occur under these circumstances. This aspect of the problem of reflux should be made the subject of further investigation. We feel, however, that the method just described was not entirely satisfactory in that it affords no means of determining the occurrence of transient regurgitation at some time during the retention period. As Guyon and Albarran have suggested, it is the first stages of urinary obstruction which are marked by violent bladder contractions and these progressively grow weaker and less frequent until complete inactivity supervenes. Reflux would be more apt to occur, therefore, in the earlier hours of retention before the bladder has reached a state of passivity through over-distention and fatigue.

SERIES D: ROENTGENOSCOPIC OBSERVATIONS

It has been our desire to produce regurgitation under conditions as nearly normal as are consistent with experimental study. In order to eliminate as many as possible of the artificial factors, we have made a series of observations on perfectly intact animals. This we accomplished by fluoroscopic examination. Aside from $\frac{1}{6}$ grain of morphia, and a whiff of ether during the adjustment of the catheter, no anesthetic was used. The animals were placed upon the X-ray table and the bladders were slowly filled with warm 25 per cent sodium bromid solution colored with India ink. Observations were made at brief intervals by means of the fluoroscopic screen until regurgitation was seen, or until it was obvious that the phenomenon was not to take place. In 2 or 3 cases we

FIG. 5. BILATERAL PYELOGRAM MADE IN A NORMAL INTACT UNANESTHETIZED RABBIT THROUGH REGURGITATION OF VESICAL CONTENTS (25 PER CENT SODIUM BROMID SOLUTION)

The phenomenon was witnessed through the fluoroscopic screen

FIG. 6. PYELOGRAM MADE THROUGH REGURGITATION OF VESICAL CONTENTS (25 PER CENT SODIUM BROMIDE SOLUTION)

The animal was normal, intact and essentially unanesthetized

exposed X-ray films for the sake of obtaining permanent records (figs. 5 and 6). At the close of each experiment laparotomy was performed under general anesthesia in order to confirm our findings. Six of 11 cases studied by this method showed unmistakable regurgitation under the fluoroscope.

X-ray experiment 11. Male rabbit; 2.5 kgm. April 14, 1922. Morphia $\frac{1}{8}$ grain. Bladder emptied of 3 to 4 cc. of urine. Catheter tied in position. Animal placed on X-ray table. Bladder slowly filled with warm solution of 25 per cent sodium bromid (colored with India ink). Vesical outline well defined fluoroscopically. With 34 cc., pressure 26 mm. Hg.; bilateral regurgitation clearly seen.

Catheter clamped and abdomen opened after ether anesthesia. Bladder found firm, small and perfectly intact. Both ureters filled with black fluid.

Note: The chief interest in the experimental study of regurgitation of vesical contents lies, of course, in its bearing upon ascending infections of the urinary tract. The fate of particulate matter carried to the kidney by means of reflux, as an analogy to the distribution of bacteria, becomes, therefore, of extreme importance. In a large number of our experiments we made use of suspensions of India ink in the fluid to be used for bladder filling, and after regurgitation occurred, studied grossly as well as microscopically the fate of the particles of carbon. Almost invariably the blood stream as well as the distant organs, such as the lungs, liver and spleen, were found to harbor generous quantities of black, most abundantly in the free leucocytes and endothelial cells. In the kidneys themselves the distribution was for the most part circulatory or lymphatic. The path of entrance from the pelvis into the renal parenchyma and into the circulation beyond, we have thus far been unable accurately to determine. In only 1 or 2 cases out of a group of some 40 experiments did we see carbon particles in the collecting or convoluted tubules.

We soon became convinced that the importance of this phase of the problem and the technical difficulties of its solution were too great to be given mere incidental consideration. We determined, therefore, that the distribution of particulate matter in regurgitation should be studied separately at a later date.

SUMMARY

Because of its bearing upon ascending types of renal infection, regurgitation of vesical contents has been made the subject of a special study.

The anatomy, pharmacology and physiology of the ureter have been reviewed, together with the work of other investigators upon the problem of reflux.

The occurrence of regurgitation was first studied in 73 normal rabbits, the bladders of which were slowly filled with warm physiological salt solution. The phenomenon was observed in 73.7 per cent of these cases. In this series attention was particularly concentrated upon the relation of the bladder to reflux.

In a second group of animals, the ureters had been rendered abnormal by previous operative procedures. Regurgitation was produced in 78.7 per cent of the attempts. These experiments afforded an opportunity to study especially the rôle of the ureter.

Several animals were subjected to complete urinary obstruction for the purpose of producing regurgitation as a result of prolonged retention.

In a final series reflux was studied in the intact animal, and the phenomenon was witnessed through the fluoroscope in 6 of 11 experiments.

CONCLUSIONS

The work which forms the basis of this communication emphasizes again that regurgitation is an experimental fact. The conditions that favor its occurrence, however, have been less well understood, and it is with these that we were particularly concerned. In the case of normal rabbits we found that the ease with which regurgitation occurred depended on a variety of factors. Chief among these was good bladder tone which seemed to be indispensable. We learned, for example, that those bladders which were relatively empty and contracted at the beginning of the preparation produced reflux twice as frequently as those which had been recently distended with large amounts of urine. Moreover, we were soon able to predict the outcome of the experiment

by observing whether the bladder wall rounded itself in active resistance to distention or was becoming filled passively like a toneless sac. Active pressure usually caused regurgitation; passive pressure never.

In the series in which the ureters had been rendered abnormal, reflux occurred just as frequently as with normal structures; and in the cases where one ureter alone was disturbed the occurrence of regurgitation did not differ in its essentials on the two sides. We conclude, therefore, that the degree of ureteral activity has relatively little bearing upon regurgitation.

We have never seen antiperistalsis in a normal ureter and in no way have we found it concerned with regurgitation.

In spite of experimental difficulties, we have seen reflux occur as a result of acute urinary obstruction.

We have demonstrated, finally, that regurgitation of vesical contents into the ureter may be observed in the normal, intact, unanesthetized subject.

Upon the basis of this work we believe that bladder regurgitation may be accountable for ascending infections of the urinary tract, particularly in cases of vesical-neck obstruction.

In subsequent papers we will discuss the effects upon reflux of variation in the type, reaction, tonicity and temperature of the fluid used in bladder fillings, together with the result of changes in the rapidity of distention. Experiments with other animals, cats and dogs, will also be reported, as will our further clinical investigations.

REFERENCES

Alksne, J.: Ein Beitrag zur normalen und pathologischen Physiologie des Ureters. Folia Urol., 1907, i, 338–365.

Bensley, B. A.: Practical Anatomy of the Rabbit. Toronto, University Press, 1910.

Brodie, T. G., and Cullis, W. C.: On the secretion of urine. Jour. Physiol., 1906, xxxiv, 224–249.

Brodie, T. G.: Renal activity. Harvey Lectures, 1909–1910, 81–91, Philadelphia, J. B. Lippincott.

Boulet and Gley: Sur les movements de l'uretere humain. Compt. rend. soc. de biol., Paris, 1913, lxxiv, 1171.

Burns, J. E., and Swartz, E. O.: Absorption from the renal pelvis in hydronephrosis due to permanent and complete occlusion of the ureter. Jour. Urol., 1918, ii, 445–454.

CABOT, H. AND CRABTREE, E. G.: The etiology and pathology of non-tuberculous renal infections. Surg., Gynec. and Obst., 1916, xxiii, 495–537.

CANNON, W. B.: The relation of tonus to antiperistalsis in the colon. Am. Jour. Phys., 1911, xxix, 238.

COURTADE, DENIS, AND GUYON, J. F.: Mémoires originaux sur le reflux du contenu vesical dans les ureters. Ann. d. mal. d. organes genitaux-urinaires, 1894, xii, 561–568.

CUSHNY, A. R.: Pharmacology and Therapeutics. Philadelphia, Lea and Febiger, 1915.

DAVID, V. C.: Ascending urinary infections. Surg., Gynec. and Obst., 1918, xxvi, 159–170.

DISSE, J.: Der Harnleiter. v. Bardeleben, Karl: Handbuch der Anatomie, Jena, Gustav Fischer, 1902, vii, 105–112.

DISSE, J.: Die Harnblase, Ibid., vii, 113–147.

DRAPER, J. W., AND BRAASCH, W. F.: The function of the uretero-vesical valve. Jour. Amer. Med. Assoc., 1913, lx, 20–24.

EISENDRATH, D. N., AND SCHULTZ, O. T.: Ascending lymphogenous renal infection. Bost. Med. and Surg. Jour., 1917, clxxvii, 10–15.

ELLENBERGER, W., AND BAUM, H.: Anatomy des Hundes. Berlin, Paul Parey, 1891.

ENGELMANN, TH. W.: Zur Physiologie des Ureter. Archiv. f. d. ges. Physiol., 1869, ii, 243–293.

FAGGE, C. H.: On the innervation of the urinary passages in the dog. Jour. Physiol., 1902, xxviii, 304–315.

FREY, ERNST: Mechanismus der Salz und Wasserdiurese. Archiv. f. d. ges. Physiol., 1906, cxii, 71.

GUYON, F., AND ALBARRAN, J.: Anatomie et physiologie pathologiques de la retention d'urine. Arch. de Med. Exper., 1890, ii, 181–221.

HAGNER, F. R.: Regurgitation of fluid from the bladder to the kidney during Ureteral catheterization. Surg., Gynec. and Obst., 1912, xv, 510–511.

HENDERSON, V. E.: Study of renal secretory activity against pressure in ureters. Jour. Physiol., 1905–06, xxxiii, 175–188.

JACOBELLI, F.: Sulla possibilita di un passaggio refluo del contenuto vescicale negli ureteri. La Riforma Medica, 1901, xvii, 27–28, 39–40.

KRETSCHMER, H. L.: Cystography. Surg., Gynec. and Obst., 1916, xxiii, 709–717.

KRETSCHMER, H. L.: The retrograde movement of ureteral calculi. Jour. Amer. Med. Assoc., 1918, lxxi, 1355–1359.

LANGLEY, J. N., AND ANDERSON. H. K.: Reflex from sympathetic ganglia. Jour. Physiol., 1894, xvi, 410–440.

LANGLEY, J. N., AND ANDERSON, H. K.: The innervation of the pelvic and adjoining viscera. Jour. Physiol., 1895–6, xix, 71–84.

LEWIN, L., AND GOLDSCHMIDT, H.: Versuche ueber die Beziehungen zwischen Blase, Harnleiter, und Nierbecken. Virch. Arch. f. Path. Anat., 1893, cxxxiv, 33–71.

LEWIN, L., AND GOLDSCHMIDT, H.: Die Resorption Körperfremde Stoffe aus der Harnblase. Arch. f. Exp. Path. u. Pharm., 1896, xxxvii, 60–68.

LEWIN, L., AND GOLDSCHMIDT, H.: Der Uebertritt von festen Körpern aus der Blase in die Nieren und in entfernte Körperorgane. Ibid, 1898, xl, 287–307.

LEWIN, L., AND GOLDSCHMIDT, H.: Ueber das Eindringen von Luft aus der Blase in das Herz und die Wege dieser Wanderung. Ibid., 1898, xl, 308–312.

LINDEMANN, W.: Ueber die Resorption in der Niere. Beitr. z. path. Anat. u. Path. (Ziegler) 1905, xxxvii, 1–27.

LUCAS, I. R.: Studies of the Peristalsis of the Ureter of Dogs by the Graphic Method. Amer. Jour. Physiol., 1906–1907, xvii, 392–407.

LUCAS, I. R.: Physiological and Pharmacological Studies of the Ureter. Ibid., 1908, xxii, 245–278.

MACHT, D. I.: A contribution to the physiology of the ureter and the vas deferens. Jour. Urol., 1917, i, 97–111.

MACHT, D. I.: Absorption of drugs and poisons from bladder and urethra. Jour. Urol., 1918, ii, 43–49, 211–226.

MACHT, D. I.: Concerning the absorption of drugs and poisons from the ureter and pelvis of the kidney. Jour. Urol., 1918, ii, 481–485.

MARCUS, HUGO: Experimentelle Untersuchungen ueber das Rückströmen von Harnblaseninhalt. Wien. Klin. Wchnschr., 1903, xvi, 725–730.

MELCHIOR, M.: Bericht ueber 52 bacteriologische untersuchte Falle von infect. Erkrankungen des Harntract. Monatsberichte des Harn u. Sexual-App., 1898, iii, 584–590.

MODLINSKI: Beitrage zur Chirurgie der Ureteren. Zentralbl. f. Harn u. Sexualorgane, 1894, v, 198 and 240.

O'CONOR, V. J.: Lavage of the renal pelvis. Jour. Amer. Med. Assoc., 1921, lxxvii, 1088–1091.

PENFIELD, W. G.: Contraction waves in the normal and hydronephrotic ureter. Amer. Jour. Med. Sci., 1920, clx, 36–46.

PIERSOL, G. A.: Normal histology. Philadelphia. J. B. Lippincott, 1912.

POIRIER, P.: Sur quelques phénomènes consécutifs aux injections urétérales. Mem. de la soc. de biol. Paris, 1891, 585–587.

POZZI, S.: Ureterverletzung bei Laparotomie. Zentralbl. f. Gynack., 1893, xvii, 97–99.

PROTOPOPOW, S. A.: Beitrage zur Anatomie und Physiologie der Ureteren. Arch. f. d. ges. Physiol., 1897, lxvi, 1–113.

QUINBY, W. C.: Infections of the Kidney. N. Y. Med. Jour. and Med. Rec., 1922, cxv, 520–523.

REHFISCH, EUGEN: Ueber den Mechanismus des Harnblasenverschlusses und der Harnentleerung. Virch. Arch. f. path. Anat., 1897, cl. 111–151.

RICHARDS, A. N.: Renal function. Harvey Lectures. (Current Volume, not yet published.) Philadelphia. J. B. Lippincott.

ROTH, G. B.: On the movements of the excised ureter of the dog. Amer. Jour. Physiol., 1917, xliv, 275–289.

ROVSING, T.: Ueber die Aetiologie, Pathogenese und Behandlung der septischen Infectionen der Harnwege. Monatsberichte des Harn u. Sexual-App., 1898, iii, 505–522.

SAKATA, K.: Ueber den Lymphapparat des Harnleiters. Arch. f. Anat. u. Entwicklungsgeschichte, 1903, i, 1–12.

SAMPSON, J. A.: Ascending renal infection with special reference to the reflux of urine from the bladder into the ureters. Johns Hopkins Hosp. Bull., 1903, xiv, 334–352.

SATANI, Y.: Experimental studies of the ureter. Amer. Jour. Physiol., 1919, xlix, 474–495.

SATANI, Y.: Experimental studies of the ureter. Ibid., 1919–20, l, 342–351.

SEMBLINOW: Quoted by ALKSNE, J.: Folia Urol., 1907, i, 338–365.

SOKOLOFF, O., AND LUCHSINGER, B.: Zur Physiologie der Ureteren. Arch. f. d. ges. Physiol., 1881, xxvi, 464–469.

SOLLMANN, T.: A Laboratory Guide in Pharmacology. Philadelphia, W. B. Saunders Co., 1917.

STARLING, E. H.: Principles of Human Physiology. Philadelphia, Lea and Febiger, 1912.

STARLING, E. H.: The glomerular functions of the kidney. Jour. Physiol., 1899, xxiv, 317–330.

STERN, LINA: Thèse de Genève, 1903.

TIGERSTEDT, R.: Textbook of Physiology (translated by J. R. Murlin). New York, D. Appleton & Co., 1906.

WARSCHAUER, E.: Beobachtungen aus der Nieren und Ureteren Physiologie. Berl. Klin. Wchnschr., 1901, xxxviii, 398–401.

WISLOCKI, G. B., AND O'CONOR, V. J.: Experimental observations on the ureters, with especial reference to peristalsis and antiperistalsis. Johns Hopkins Hosp. Bull., 1920, xxxi, 197–202.

YOUNG, H. H.: Hydraulic pressure in genito-urinary practice especially in contracture of bladder. Johns Hopkins Hosp. Bull., 1898, ix, 100–113.

YOUNG, H. H.: (Discussing paper by J. A. Sampson), Johns Hopkins Hosp. Bull., 1903, xiv, 350-351.

ZEISSL, M.: Ueber die Innervation der Blase. Arch. f. d. ges. Physiol., 1893, liii, 560–575.

PRIMARY CARCINOMA OF THE URETER

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Of the malignant tumors occurring in the ureter, carcinomata are more common than sarcomata. Carcinoma occurring in the ureter may be primary or secondary. Secondary carcinoma may originate in the kidney pelvis by direct extension or the ureter may be involved by a carcinoma of the bladder. The ureter may also be involved secondary to a carcinoma of the uterus or the ovary.

Aschner, in a recent article, was able to collect 47 cases of primary tumors of the ureter, including both benign and malignant cases. It would thus appear that primary epithelial tumors in the ureter are rare.

This paper will be limited to a consideration of primary carcinoma of the ureter. From the available literature I have been able to collect 34 cases to which I wish to add a case under recent observation, thus bringing the total number of cases of primary carcinoma of the ureter available for discussion up to 35 cases. The case under recent observation is the following.

G. M., aged seventy-four. Referred by Dr. Charles Collester.

Previous illnesses. Twenty years ago patient was operated upon for carcinoma of the lip. Complete cure.

Present complaint. Patient was well until five weeks before he came under observation when he began to pass dark red urine. Since the onset of the trouble the urine was never entirely free of blood. The amount of the bleeding varied so that at times the urine was either very dark red or light red. Blood and urine were well mixed: occasionally clots were passed. Nocturia has been present for several years. During the last two months he has lost about 10 pounds in weight.

Examination. General physical examination was negative. Scar from the previous operation for carcinoma of the lip was normal. No

local recurrence. Kidneys, ureters and bladder negative. Rectal examination showed a slight enlargement of both lateral lobes of the prostate.

Cystoscopic examination. A definite trabeculation of the bladder was seen and at the vesical neck a large median bar was found. The ureteral orifices were normal. No signs of tumor in the bladder or in or around the ureteral orifices. Ureters were catheterized without difficulty or obstruction.

Pyelogram. On the right side the catheter took a most unusual course, i.e., upward and outward in an S-shaped curve, the tip overlying the midpart of the crest of the ilium. At the level of the second lumbar a dense rounded shadow was seen, the size of a half dollar. There was marked lipping of the lumbar spine and thickening of the sacro-iliac joint. No stone shadows were seen.

Cell count and cultures were as follows:

	LEUCOCYTES PER CUBIC MILLIMETER	CULTURES	TUBERCLE BACILLI
Bladder	310	Sterile	Negative
Right kidney	190	Sterile	Negative
Left kidney	50	Sterile	Negative

Operation, September 3, 1922. The patient left the city and returned to his home where he was operated upon by Dr. Phemister, to whom I am indebted for his kindness in turning over the specimen to me for study. The usual oblique lumbar incision was made over the right side and a lumbar nephroureterectomy was performed. The patient made an uneventful recovery.

SEX

According to the cases reported the incidence of sex seemed to play little, if any, rôle. Males were more frequently affected than females, but the difference was so slight as to be negligible. The number of males, including the case here reported, amount to 19; females, 16.

AGE

Here, as in other forms of malignant disease of the urinary tract, it may be stated that this occurred with greater frequency in advanced years, although there were exceptions to this statement.

The exceptions were the cases of Albarran, thirty-six years; Finsterer, thirty-five years; Zironi, thirty-six years; Aschner, thirty-eight years. There were 2 patients, aged eighty: 1 reported by Richter, the other by Toupet and Guebiat. Curiously enough both these patients were females. The following table shows the incidence of age.

	number of cases
30 to 39 years	4
40 to 49 years	7
50 to 59 years	9
60 to 69 years	9
70 to 79 years	2
80 to 89 years	2
Age not stated	2

PRESENCE OF CALCULI

Although it has repeatedly been stated that the presence of stone may be an etiological factor in causing carcinoma, and in order to support this statement attention has been called to the frequency with which stones and carcinoma of the gall bladder are found at the same time, it would seem that in the urinary tract, stones and carcinoma do not occur simultaneously as often as in the biliary tract. Evidently stone is of no moment as an etiological factor in causing carcinoma of the ureter since only in 5 cases was it present. Its occurrence in the ureter has been mentioned by Davy, Metcalf and Safford, Paschkis and Zironi. In Judd and Struthers' case, the patient stated that he passed a stone. In the St. Thomas Hospital case, stone was present in the opposite kidney, and in Aschner's case it was found in the kidney on the corresponding side.

PATHOLOGY

Type of tumor. From a review of these 35 cases it appears that the papillary form of carcinoma occurs most frequently in the ureter, since 18 of the 35 cases were of this type. Next in point of frequency were the medullary carcinomata, 5 cases, and the squamous-celled carcinomata, 5 cases. In 1 case the tumor was described simply as an epithelioma. No further

histological description was noted. Epithelial carcinoma was the term used to describe 2 cases. In 2 cases the tumor was described as transitional-celled carcinoma. In 1 case the term carcinoma solidum simplex was used and in another case, simply carcinoma.

Since squamous cells are not normally present in the renal pelvis, the presence of squamous-celled carcinoma brings up for discussion the interesting question of metaplasia, the occurrence of which has been previously discussed.[1]

	number of cases
Papillary carcinoma	19
Squamous-celled carcinoma	5
Medullary carcinoma	5
Epithelial carcinoma	2
Transitional-celled carcinoma	2
Epithelioma	1
Carcinoma solidum simplex	1
Carcinoma	1

One of the most constant concomitant pathological findings is hydronephrosis. This is but a natural development as it is the direct result of the tumor producing a stricture or obstruction within the ureter, with a resulting hydronephrosis above the obstruction. Hydronephrosis has been recorded as present in 26 of the 35 cases. In 9 cases neither the presence nor absence of hydronephrosis was noted. It is possible that the real incidence of hydronephrosis is larger than appears from a review of the literature since some of the authors may have neglected to report its presence. In the case reported in this paper a small hydronephrosis was found above the tumor. This was demonstrated by the pyelogram before operation.

Metastases

It would appear that metastases occur in these cases as frequently as in any other form of carcinoma. In 3 cases bone metastases were stated to be present: lumbar vertebra (Adler),

[1] H. L. Kretschmer, Surg. Gynecol. and Obstst., October, 1920; Archives of Surg., September, 1922, v.

ilium (Hektoen), spine (Schmitt). The following distribution has been reported:

Liver and lymph glands	Davy
Right lung and bladder	Gerstein
Liver, lungs and lymph glands	Rundle
Liver, left kidney and spine	Schmitt
Liver, lung and lymph glands (2)	Voelcker and Vorpahl
Right kidney	Israel
Nerves	Kidd

It is interesting to note that in 5 of the 8 cases there were metastases in the liver, which appears to be more frequently the seat of metastases than any other organ.

Location in the ureter

A study of these 35 cases shows that carcinoma occurs more frequently in the lower portion of the ureter since in 19 cases it was found at varying parts in the lower third. In 2 cases it was stated that the tumor was situated in the middle of the ureter and in the remaining 8 cases the upper ureter was involved. The entire ureter, or practically the entire ureter, was involved in 6 cases.

SYMPTOMS

Hematuria heads the list of symptoms because it is the most constant symptom, having been present in 24 of the 35 cases. In some of the remaining cases no mention is made of bloody urine. This probably does not represent accurately the exact status regarding the occurrence of hemturia, in view of the fact that some of the cases, being autopsy cases, received only brief mention. In several cases definite statements were made that blood in the urine was absent (Adler, Von Capellen, Hektoen, Toupet and Gueniot, Wising and Blix. Pain was a most important and constant symptom, being present in 26 of the 35 cases. There was nothing characteristic about this pain from which a diagnosis of carcinoma of the ureter could be made or surmised, nor was it always referred to the same place. In 21 cases pain was the first symptom noted, and was most frequently referred to the back on the corresponding side on which the tumor was found. The most frequent terms used by the authors in

describing the location of the pain were, lumbar region, region of the kidney, in the back and in the abdomen. In 5 cases the pain was referred to the hip (Hektoen, Gerstein, Spiess, St. Thomas Hospital and Kidd). In some of the cases the pain, no doubt, was due to the hydronephrosis.

DIAGNOSIS

The diagnosis from the history and physical examination is almost impossible, especially when the tumor is small, but when it reaches a large size so that it can be felt by abdominal palpation, the diagnosis can be made or surmised. In women it is possible to palpate the tumor through the vagina and in men carcinoma of the lower ureter may be felt through the rectum. In order to make an accurate diagnosis, it will be necessary to resort to the use of special diagnostic aids, such as cystoscopy, ureteral catheterization and pyelography. In cases in which the tumor protrudes from the ureteral orifice, the diagnosis can be made by the cystoscope or a diagnosis may be ventured when there is profuse hemorrhage from the ureter associated with obstruction, as demonstrated with the ureteral catheter, assuming, of course, that stone and stricture have been excluded. But we must not forget that both stone and carcinoma may occur at the same time. Persistent bleeding from the ureter after nephrectomy is highly suggestive of ureteral neoplasm. In a recent letter from Dr. Collester he informed me that the patient, whose case is here reported, has again passed blood in the urine. This probably means that the patient has recurrence of tumor formation in the stump of the ureter.

In view of the fact that hydronephrosis is so frequently found, pyelograms may give some additional information. The present literature contains nothing in the way of pyelographic data since most of the cases were published before pyelograms became part of our routine examination.

A pre-operative diagnosis of carcinoma or tumor of the ureter was made by Albarran, Chevasse and Mook, Gerstein, Judd and Struthers, Rathbun, Richter and Zironi. The following is a list of some of the pre-operative diagnoses made: sarcoma of

the ilium (Butler); pyonephrosis (Von Capellan); bladder papilloma (Finisterer); ureter calculus (Metcalf and Safford); carcinoma of kidney (Rundle): rheumatism and dementia praecox (Spiess); papilloma of the kidney with secondary involvement of ureter (Kidd).

A diagnosis of tumor of the kidney with hydronephrosis was made in the case reported here. This was based upon the age of the patient, slight loss of weight and a persistent painless unilateral renal hematuria, and the pyelogram.

REFERENCES

Adler, L.: Monatsber. f. urol., 1905, x, 129.
Albarran, J.: Ann. d. med. gen. urin., 1900, xviii, 918.
Aschner, P. W.: Surg., Gyn., and Obst., December, 1922, 749.
Butler, F. A.: Clifton Med. Bul., 1914, ii, 48.
Chevasse, M., and Mock, J.: Bul. et. mem. Soc., Chir. Par., 1912, xxxviii, 522.
Chiari, O. M.: Ztschr. f. urol., 1914, viii, 672.
Davy, R.: Brit. Med. Jour., 1884, ii, 757.
Finisterer, H.: Wien. Klin. Wchschr., 1915, xxvii, 718.
Gerstein, K.: Inaug. Dissert., Kiel, 1902.
Hektoen, L.: Trans. Chicago Path. Soc., 1895, 97, ii, 132.
Israel, J.: Berl. klin. Woch., 1910, xlvii, 2381.
Jona, G.: Centrlbl. f. allg. Path. u. path. Anat., 1894, v, 659.
Judd, E. S., and Struthers, J. E.: Jour. Urol., 1921, vi, 115.
Kidd, Frank: Personal communication.
Knack, ———: Deutsch. med. Wchschr., 1918, xliv, 982.
Kretschmer, H. L.: Surg., Gyn. and Obst., October, 1920. Arch. Surg., September, 1922, v.
Lowenstein, E.: Inaug. Dissert., Freiberg, 1911.
Metcalf, W. F., and Safford, H. E.: Amer. Jour. Med. Sci., 1905, cxxix, 50.
Minick, C. K.: Pest., ed. chir., Pressc., 1902, xxxviii, 941.
Paschkis, R.: Wien. klin. Wchschr., 1910, xxiii, 361.
Paschkis, R., and Pleschner, H. G.: Med. Klinik., 1920, xvi, 2, 1254.
Rathbun, N. P.: Internat. Jour. Surg.
Richter, J.: Ztschr. f. urol., 1909, iii, 416.
Rundle, H.: Trans. Path., Soc., Lond., 1896, xlvii, 128.
Schmitt, E. E.: Trans. Chicago Path. Soc., 1915, 18, x, 127.
Spies, P.: Centrlbl. f. allg. path. Anat., 1915, xxvi, 561.
Suter, F.: Zeitschrift f. urol. Chir., x, 522.
St. Thomas Hospital: St. Thomas Hospital Reports, London, 1904, xxxii, 96.
Toupet and Gueniot: Bul. Soc. Anat. Par., 1898, lxxiii, 677.
Vorpahl, K.: Inaug. Dissert., Greifwald, 1905.
Voelcker, A. F.: Tr. Path. Soc., Lond., 1895, xlvi, 133.
Von Capellen: Beitr. z. klin. Chir., 1916, xcix, 138.
Wishing, P. J., and Blix, C.: Rev. d. sc. med., 1878, xviii, 457.
Zironi: Amer. d. mal. org. genito-urin., 1909, i, 81.

DESCRIPTION OF TWO PROCEDURES FOR THE RELIEF OF OBSTRUCTIONS AT THE VESICAL END OF THE URETER

PRESENTATION OF A HIGH FREQUENCY CYSTOSCOPIC SCISSOR INCISOR

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Obstructions at the vesical end of the ureter are being appreciated more and more as significant factors in defective emptying of the ureter and renal pelvis with the coincidental symptoms and findings so often mistaken for other conditions. Our growing appreciation of the importance of either constrictions or valvular obstructions at this part of the urinary tract is due to the more intimate relationship between roentgenology and urology. Diagnosis of such lesions depends entirely upon the affiliation of these two branches; while the cystoscope discloses the topography of the ureteral orifice, and, with the ureter catheter, may suggest obstruction, we must depend upon ureterographic study for its verification, since many ureteral orifices which appear small are not productive of obstruction, and, furthermore, many orifices which appear normal in size, shape and position are in association with enormous ureteral dilatations. My experience has been that with the largest ureters, the ureteral orifices themselves have given no indication of stricture. In the megalo-ureters there has seldom been the slightest indication of orifice constriction. The 3 cases of very large ureters which I have seen have readily admitted 2 or 3 No. 6 ureter catheters; on the other hand, the very small ureteral orifices have seldom been associated with large dilatations. Such obstructions have a tendency to produce moderate dilatations and more toruosity. These tortuosities, haustrations, irregularities and spasms originating from intramural obstructions are frequently mistaken for upper ureteral

strictures. Juxta-vesical stricture is not an uncommon diagnosis, indeed ureterograms of dilated ureters frequently convey the impression that most of the lower ureteral strictures are just external to the bladder. Let us not forget that the point of least resistance is in this location and that dilatation within the wall of the bladder would be difficult, if not impossible. We can thus see that obstruction within the bladder would convey such an impression, the first dilatation being at the point just the distance of the thickness of the bladder wall away from the site of obstruction.

In my paper before this Association a year ago I discussed some of the causes of lower ureteral obstructions and gave credence that such obstructions were responsible for most ureteral dilatation, but reserved a place for certain other massive ureteral enlargements in which no obstruction could be demonstrated to developmental defects in the ureter itself.

My experience during the past year has convinced me that these ureteral enlargements present two distinct types, in all probability of different pathogenesis, however, they are both productive of deleterious influences and demand relief of obstruction to effect a cure. A large ureteral orifice is proportionately as small to the monstrous ureter as a small orifice is to the less distended canal.

Let us then consider the most important phase of this condition, the manner in which it can be relieved, for, after all, the cure of the patient is our aim. The patient whose case I reported a year ago with unilateral hydro-ureter of ten ounce capacity has been well as a result of an incision one-half inch long made by means of scissors which passed into the urethra beside the cystocope. This free incision caused immediate emptying of the ureter and almost immediate resumption of active peristalsis. It has now been twenty months since this operation and on May 14, three days ago, the patient was examined; ureteral orifice is as open as it was at the last report, cystogram shows free regurgitation up the ureter and the patient empties the ureter almost immediately.

Being so gratified with this result, appreciating the importance of such free opening, and being so frequently disappointed in the effect of the operation by means of the usual cystoscopic scissors and the ureteral meatotomes which I have employed, I have endeavored to construct an instrument which would effectively incise the ureteral orifice through a cystoscope. Realizing that the ordinary instrument would not accommodate scissors of sufficient size and strength to adequately accomplish this purpose, I have made an instrument in which neither power nor size figures prominently.

This *high frequency cystoscopic scissor* has very effectively incised the orifices in 6 patients, 2 for calculi, and 4 for stricture at the vesical end of the ureter. The operating or cutting parts of this instrument are made of a special non-corrosive metal but insulated in such a way as to carry the current through the center of an insulated flexible catheter-like sheath. In the center of the insulated sheath is run a small metal spring wire of non-corrosive material threaded through its entire length. This conducts the D'Arsonaval current from the anterior end where the cords from the D'Arsonaval apparatus, or generator is connected by a suitable quick-acting slip joint with an insulated cover. Connecting on the insulated finger forceps this conducting wire leads down to the knife proper which opens and closes in its case or sheath. The mechanism of this knife is so arranged that only the knife edge protrudes from the insulating sheath. This knife has a double edge cutting as it closes also cutting as it opens, and may be used according to the will of the operator. All other parts are enclosed in insulation so as not to cause an electrical contact or burn from the bottom side or heel of the knife carrier. This case or sheath enclosing or operating the knife must be made of insulating material. Ivory, being the hardest material yet known, is selected for this important posterior ending.

This instrument is used through an operating cystoscope, preferably one with direct vision. The ivory tip engages in the orifice, then the blade is opened the tip being pushed up the ureter until the mucous membrane at the ureteral orifice reaches the angle of juncture between the blade and the ivory tip (fig. 1). Then the scissor is pressed together and the blade lightly pressed against the mucous membrane. Current is then applied. In some instances it works very rapidly, makes a clean cut with a white margin on either side of the blade. As the burning

progresses, the instrument may be forced further in the orifice and a more extensive incision made. There is practically no bleeding and vision is usually quite perfect. Several of the cases have had a moderate amount of blood in the urine following the burning. It is quite wise to use sacral anaesthesia for this operation since the burning causes

FIG. 1. CYSTOSCOPIC SCISSOR ENGAGED IN ORIFICE.

considerable pain under local anaesthesia. I have injected the orifice with cocaine through a special needle, but have discarded it for the reason that the swelling from the injection creates so much bulk as to interfere with the proper incision.

All of the 4 cases of stricture were associated with infections, and moderate ureteral dilatations, all were suffering with renal or

ureteral pain; they have all been relieved after incision of the orifice. They have all been done within the last year, the longest time since operation has been eight months, the shortest, two months. They have shown no recurrence of symptoms. It seems, therefore, for certain obstructions, this instrument is capable of giving sufficient opening for relief and, on account of the clean-cut incision which is made, reactionary scarring and recontracture have not been observed. In instances where this method is ineffective, a transposition operation upon the ureteral orifice through a suprapubic incision is indicated. I have done this operation twice, both times on each side. The first patient was done last July for large bilateral hydro-ureters associated with marked destruction of the kidneys, severe infection, nitrogen running between 80 and 100, a very bad surgical risk. This boy had been drained repeatedly with ureter catheter and had been treated for pyelitis for several months without the slightest benefit. Under gas anesthesia, suprapubic incision was made, bladder opened freely. There was no obstruction apparent at the internal orifice. Ureteral orifices themselves looked normal and admitted 3 No. 6 catheters. The left intra-mural ureter seemed very thick, being visible as a rounded cord under the mucous membrane of the bladder. The ureteral orifice was grasped with Allis' forceps and an incision made through the mucous membrane outward. The intra-mural ureter was the size of my little finger and was firm and thick-walled; it was lifted from its bed as in (fig. 2a), and split. It was then circularly amputated just at its entrance to the bladder. The mucosa of the ureter and vesical mucosa was stitched by interrupted stitches making a circular orifice which would admit the index finger at least $\frac{3}{4}$ inch away from the original opening (fig. 2b). The left ureter was exposed for a short distance in order to study the wall. It was immensely thickened; section made from the resected intra-mural ureter showed it to be composed of considerable muscle tissue with intermingled fibrous connective tissue. This part of the ureter was not composed of dense sclerosis. This, in other words, gives no evidence of pronounced stricture. The same operation was done on the other ureter and a large No. 24, soft rubber catheter was passed

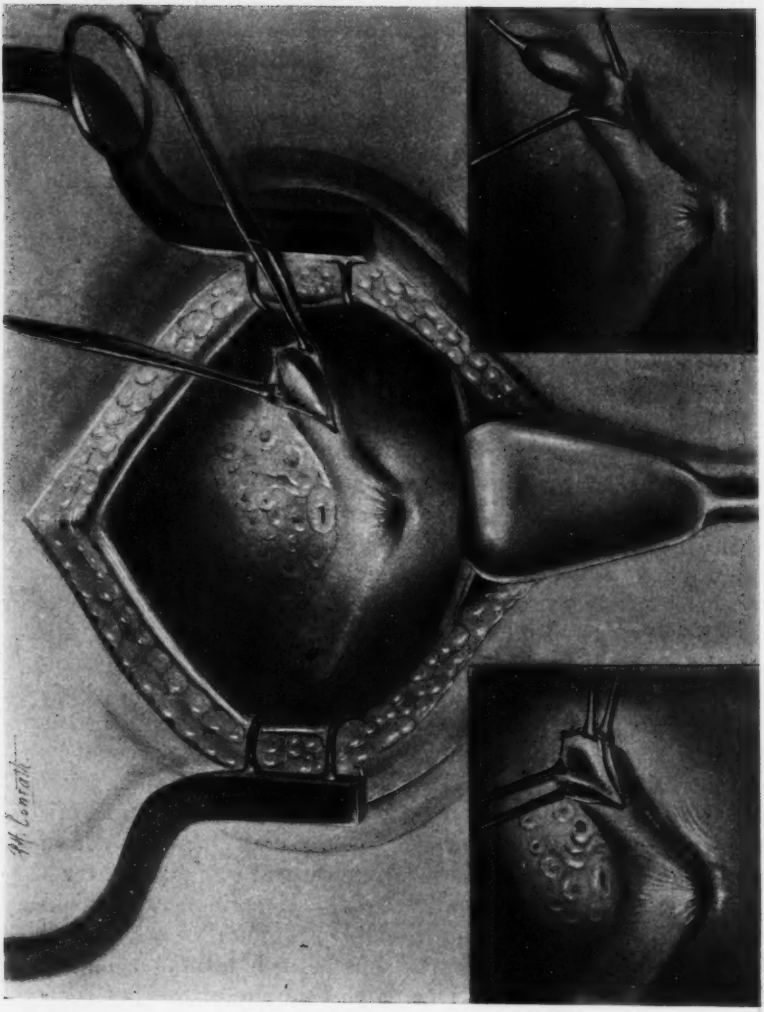

FIG. 2a.

into the ureter on each side and retained by a traction suture; these were brought out the supra-pubic wound for drainage, bladder closed around them. The patient stood the operation well, tubes were left in four or five days, wound closed in six weeks. He returned just recently, has gained 20 pounds, feels wonderfully improved, cystoscope shows two enormous ureteral orifices giving the appearance of diverticulae; his urine is considerably improved. Cystogram shows immediate filling

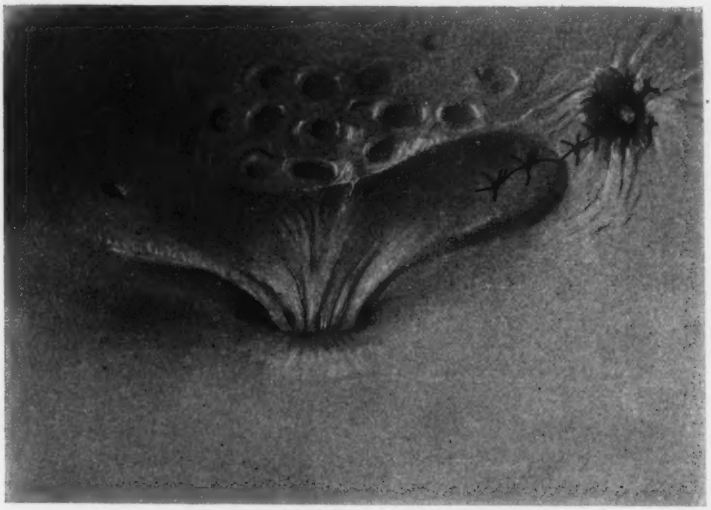

FIG. 2b.

of ureters and renal pelves, the junction to the bladder giving no constriction. On emptying the bladder, patient within five minutes was radiographed and a complete emptying of the ureters and renal pelves had taken place. Before operation there was no regurgitation in the ureter; on filling his ureters it took considerably over an hour before they were emptied.

Within the last month I have done a similar operation on a child three years of age at the St. Louis Children's Hospital who had been treated for pyelitis for a long period of time. She was extremely ill, very emaciated, septic, urine was very dirty,

FIG. 2a.

nitrogen high, phthale in low, and large tender left kidney. Cystoscope showed ureteral orifice to be soft and pliable and, even in such a small child, 2 ureter catheters could be passed into the ureter, the ureters being equally as large as the adult's above described. The urine from the left side was thick and creamy. This operation was done several weeks ago; there was no scarring of the ureteral orifice, I could find no valvular folds, and the ureters themselves were enormously thickened. The same operation was done as above described. The child made an uninterrupted recovery and at present is doing remarkably well. There is still a slight suprapubic drainage but she has gained in weight and looks like a different child. Recent cystogram was unsatisfactory; but showed considerable regurgitation up the left ureter, the one so severely diseased; but none up the right.

CONCLUSIONS

1. Intravesical obstructions of the ureter are quite frequent in their occurrence, hence the importance of combined cystoscopy and ureterography.

2. Such obstructions seem to originate from the two distinct causes, obstructions which may be congenital or acquired, and developmental defects in the ureter itself.

3. Regardles of cause, free incision of orifice for drainage is necessary.

4. Present cystoscopic methods are unsatisfactory.

5. *High frequency scissors* has worked effectively in certain obstructions.

6. Where cystoscopic methods are inadvisable or impossible, free opening of the ureteral orifice by intra-vesical transposition operation is indicated.

7. This operation is much less hazardous and much more effective than uretero-vesical anastomosis.

DISCUSSION

Dr. Benjamin S. Barringer (New York City): I would like to ask Dr. Kretschmer if he has used Dr. Beer's method of passing the ureteral catheter up and getting it at different levels—the hemorrhage returns when the catheter strikes a certain level. I think Dr. Beer has made a diagnosis by that method of ureteral carcinoma.

Dr. A. H. Crosbie (Boston): I have an interesting cystogram here that I would like to show—a man who fifteen years ago had his left kidney removed. It was double kidney with double ureter, with an opening of one ureter into the prostatic urethra. He came complaining of frequency, and of passing foul urine. On cystographic examination we found abullous edema on the left side, but no opening. The cystogram showed this large stump of the ureter, which apparently is the place all the pus is coming from. (Lantern slide.) Pyelograms of the right side of the kidney were negative, and the urine was negative.

Dr. Herman L. Kretschmer (Chicago): I was much interested in Dr. Graves' paper. Papers of this kind will get us back to the old idea that there is more than one possible route of renal infection. Many of the publications of recent times deal with renal infections only from the standpoint of the hematogenous route. It was well known among the older clinicians that there was a so-called ascending route of infection, and I think the fact that they were correct in their deductions is illustrated by the large series of regurgitations which Dr. Graves has been able to demonstrate. Retention of urine following surgical operations is not an uncommon occurrence so that patients are obliged to be catheterized. After being catheterized for one or two days, evidence of urinary tract infection occurs, the patients subsequently developing chills, fever and pain in the back. It would

appear from the sequence of events in some of the cases of this type that the renal infection was of the ascending type.

I think the phenomenon of regurgitation can be explained in the following manner: The patient has a bladder full of fluid, and the moment the ureterovesical valve opens up and allows the urine to come down from the kidney pelvis there is an upward propulsion of bladder contents due to contraction of bladder musculature.

Dr. Caulk called attention to the fact that some of these ureters were much dilated in cases where the ureteral openings were normal. I think a very graphic type of case which illustrated the enormous amount of dilatation which can be obtained in the ureter and still have a normal orifice, is that of the dilatation of the ureter during pregnancy. We have all seen cases where the pyelogram shows an enormously dilated kidney pelvis, with the orifice apparently normal, and this dilatation disappears rapidly after confinement.

I would like to answer Dr. Barringer about the diagnosis of carcinoma of the ureter. We used the method he spoke of, and when our catheter went into what we thought was the kidney pelvis we immediately had hemorrhage, and partly because of this we diagnosed a tumor of the kidney. However, as the pyelogram shows, the catheter is nowhere near the tip of the kidney. So the fact that the ureteral catheter meets with an obstruction, with or without bleeding, does not mean that the tumor is in the ureter, because the same phenomenom may occur in tumors of the kidney.

Dr. Hugh H. Young (Baltimore): These papers are of great interest and value to the Association. I did not hear the first paper, so I refer to the second and third. The paper by Drs. Hinman and Morison with regard to the development of hydronephrosis shows the remarkable vascular changes that occur, and explains in a way that never has been done before how rapidly renal dilatation occurs, and how rapidly it disappears when the obstruction is relieved. The demonstration that in hydronephrosis the blood vessels are drawn out, narrowed and eventu-

ally occluded and therefore cut off the blood supply to the cortex of the kidney, and as soon as the obstruction is removed the vessels have a chance to come back to their normal size, seems to explain why the kidneys are so quickly improved. In other words, it has not been the cortical changes or destruction of renal functional capacity, but simply because the blood supply to the cortex had been cut off. It is to me a very beautiful demonstration of what has been heretofore a very obscure problem.

Dr. Graves' work on the physiology of the ureter, particularly in regard to reflux, is extremely interesting. I have been interested in this question for a number of years, and in a paper on the treatment of contracture of the bladder, I brought out the method of dilating the bladder mechanically by hydraulic pressure. The question at once arose whether the fluid would be forced into the ureter and thereby carry infection into the kidneys. The experiments we carried out showed that when the bladder is greatly distended the fluid did not go up, so apparently the method of treatment was safe. The Doctor has explained that it is not when the bladder is greatly distended that the regurgitation occurs, but before that time arrives. Why this is so, I do not know if he has explained. Courtade and Guyon said it is due to localized contraction on the part of the bladder.

I have never accepted the view that infections never went up the ureter, that they always took a circuitous route, retroperitoneally. There has been advanced the idea that it was impossible for the epididymis to be involved, that it had to be reached by the lymphatics; but Albarran and all others used to ligate the vas deferens to prevent epididymitis after prostatectomy, and succeeded. But this work and the work of Kretschmer has restored us to our normal state of mind in regard to ascending renal infections and prove that it is the most common way in which the pelvis becomes infected.

Dr. Caulk has certainly opened up a broad field in his studies of dilatation of the ureters without apparent cause and with the orifices normal. It is an extremely important problem. I do not think he pretends to have solved it, nor to say why so many of these dilatations occur where you cannot find any lesion at all.

Last year I referred to such a case, where we could pass a No. 26 sound up the ureter, and with no obstruction at the urethral orifice. I was never able to explain why she had ureters dilated to almost the size of the small intestine.

These three papers are of very great importance, because they deal with problems that have been difficult to understand for many years.

Dr. Nathaniel G. Alcock (Iowa City, Iowa): We have been doing some work in relation to dilatation of ureters in normally pregnant women, and we have been surprised at the enormous size of some of these ureters in cases without symptoms and without any signs of infection. In these cases we have noted no changes in the orifices of the ureters, and the dilatation in nearly all of them extended from a point just above the orifice clear up to the pelvis of the kidney. Some of the cases have been followed for a year or more and it is surprising to note the return to normal size again.

Dr. F. H. Falls has offered the suggestion that this dilatation is due to their toxemia—the same condition that causes a decrease of peristalsis of the intestine with resulting chronic constipation.

In some of these ureters we have found as much as 95 cc. of residual urine without symptoms, and in some of the infected cases as much as 125 cc.

Dr. John H. Cunningham (closing): In offering this antiseptic pyelographic medium it is not with the idea of bringing forth an antiseptic solution for lavage of the kidneys—simply to render the pyelographic solution antiseptic.

Dr. R. C. Graves (Boston): I only wish to thank you for the honor you have conferred upon me in permitting me to appear before this body. I assure you this meeting is a pleasure and a very great stimulus to me.

Dr. John R. Caulk (closing): My interpretation of dilatation of the ureter or kidney in pregnancy is that it is purely a

mechanical process due to pressure by the uterus. But this type of massive ureter seems to me entirely different from the others. Those from mechanical obstruction are usually thin walled, but these ureters have thick, solid, heavy muscles. The man we operated upon, and made the exploration to locate the ureter, had a ureteral wall as thick as three ureter walls should be. The intra-mural ureter was not dense scar tissue, it was muscle and fibrous tissue. In other words, it is entirely different from the mechanical type and I think is purely a development affair, just as one person may have a thick upper lip, or a large nose—so he may have a thick ureter.

A LATER ESTIMATE OF THE VALUE OF URETERO-COLOSTOMY IN CANCER OF THE BLADDER

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Two years ago I read before this Association a paper entitled "Radical treatment of cancer of the bladder (1)." In this paper the history and technic of uretero-enterostomy were discussed, and the belief was expressed that "total cystectomy should be done much more frequently than it is done at present." Four cases were reported in which uretero-enterostomy had been done. Two of these died as a direct result of the operation. In a third case the anastomosis of the left ureter with the sigmoid functioned well, whereas the implantation of the right ureter, which was much dilated, was unsuccessful, necessitating a right nephrostomy. This patient had too extensive a cancer to permit of cystectomy; he died some eight months after his last operation. The fourth patient also had too extensive a cancer to warrant cystectomy; his ureteral anastomoses were successful, but he died five months after the implantation of the ureters.

In all of these cases the bladder was extensively involved when the patient was first seen. The operations were done because it was hoped that a successful diversion of the urinary stream would relieve the suffering caused by the vesical condition.

Since that time 5 other cases have been subjected to uretero-enterostomy. Three of these were in a class with the preceding 4, that is, the extent of the growth made cystectomy a surgical impossibility. The other 2 were, or seemed to be, favorable cases for cystectomy. In 4, uretero-enterostomy was done upon one side at a time. In the fifth, only one ureter was anastomosed, as the other was already occluded by the growth in the

bladder. Anastomosis was done extraperitoneally, the right ureter being implanted into the ascending colon, the left ureter into the descending colon. The technic of Coffey was followed.

In the 3 advanced cases, the procedure was successful in 2.

W. J. R., a barber of sixty-one, was admitted to the Massachusetts General Hospital because of bladder symptoms. Examination showed a firm tumor the size of a tennis ball, situated in the region of the bladder. Cystoscopy showed a malignant growth involving the bladder to a very advanced degree. It was thought unwise to open the bladder. As the patient was suffering a great deal from his vesical symptoms, it was decided to divert the urinary stream. May 10, 1922, a right ureterocolostomy was done through an incision along the outer border of the right rectus. This incision gave a very good exposure. Following the operation there was some leakage of fluid (probably urine) but this soon stopped. May 31, the left ureter was implanted in the descending colon. The ureter was thin walled and dilated to a diameter of at least 1 cm. In spite of this, the anastomosis held and the patient was discharged from the hospital on June 25 with good control of his rectal sphincter. His non-protein nitrogen five days before the first operation was 43 mgm. per 100 cc.; three days before discharge it was 54 mgm. per 100 cc. He died February 9, 1923. Dr. W. O. Faxon, of Stoughton, Mass., writes as follows concerning this patient:

"For some few weeks after he left the hospital I did not attend him as he seemed to be quite comfortable and did not suffer a great deal of pain. In the early part of January, 1923, he commenced to have more or less pain although the urine passed by rectum very freely. It was necessary to give him morphine, which I did per oram, and in that way kept him very comfortable and I would only see him every four or five days. He sank very rapidly after February 1. I saw him February 6 and he died on the morning of February 9. The only particular symptom that developed was the severe pain in the bladder which I was obliged to control, as I said before, by opiates."

The other successful case was that of a woman aged sixty-six, upon whom I had done a cystotomy with implantation of radium three months previously. She left the hospital where the operation was done, before her cystotomy was healed, and suffered so much from her bladder that something had to be done. A left uretero-enterostomy was done, which functioned perfectly. As the right ureter appeared to be occluded by

the growth, nothing was done to the right side. The patient's doctor reported that she was comfortable after the uretero-enterostomy until her death a month or two later.

The third patient was a cachectic individual, a carpenter of forty-eight. On December 17, 1921, I cut down on his bladder, which cystoscopically was seen to be very generally involved by a malignant growth. When the bladder was exposed, it was felt to be a solid mass the size of a baseball. The only thing to do to give the patient relief seemed to be to transplant his ureters. This was done first upon the left, and eighteen days later on the right. The left anastomosis worked well for several weeks and then the urine began to escape from the wound. Urine leaked from the right anastomosis shortly after it was done. The patient was discharged to a chronic hospital with bilateral urinary fistulae.

Of the 2 favorable cases, 1 was a man of forty-seven upon whom I had operated September 1, 1921, for carcinoma of the bladder. At that time the bladder was opened and radium seeds were implanted into a growth 1 by 2 cm., situated just posterior to the right ureter. Four months later cystoscopy showed an extensive papillary carcinoma scattered all over the bladder, and especially abundant around the vesical neck and upon the roof. The growth appeared to be superficial; there was no induration to be felt on rectal palpation, and there were no masses in the abdomen. The man was spare and tough, and apparently in excellent general condition. January 4, 1922, right uretero-enterostomy was done. On January 8 he began to pass urine by rectum. His temperature was elevated for a week, then became normal. January 17 the left ureter was implanted. The patient was quite distended after this operation, but two weeks later he was passing 120 ounces of urine every twenty-four hours, 16 ounces at a time. The urine contained no pus. On February 7 total cystectomy was done. Both suprapubic and perineal incisions were made. In freeing the bladder by the latter route, the rectum was torn. A fistula persisted for a few weeks, but finally closed. Pathological examination of the bladder, after its removal, showed that about one-third of the

interior surface had undergone carcinomatous changes. The area into which the radium had been implanted four months before showed a chronic inflammatory reaction with great increase in connective tissue and with constriction and replacement of the cancerous tissue. On April 6 the patient was discharged from the hospital. June 14 he reported as follows: "Gain of 15 pounds in weight. Holds urine four or five hours. Eats and feels well. Has played cricket. Has some sexual desire but no erections." Shortly after this he began to have severe pain in the back. X-ray showed a pathological process involving the fifth lumbar body and some atrophy of the wing of the sacrum. There was a shadow in the region of the left kidney. X-ray treatment was instituted but the pain continued and death ensued early in October, eight months after cystectomy. Unfortunately there was no autopsy.

This case illustrates the folly of attempting so radical a procedure without first having exhausted every possible means of detecting the presence of metastases. X-rays should have been taken of the spine and pelvis before operation was advised. It is quite arguable, however, that at that time the metastasis would not have been sufficiently advanced to appear in the X-ray.

The other apparently favorable case was a woman of fifty-six in excellent general condition. She had had bladder symptoms for at least six months; for five months she had been treated by bladder lavage, and lately had had a so-called papilloma of the bladder fulgurated. Cystoscopy, June 12, 1922, showed a sloughing tumor about 2 or 3 cm. in diameter situated somewhat above the left ureteral region. The tumor was surrounded by a depressed area with a sharp edge. From this area a line of elevated, slightly necrotic tissue extended down across the trigone and apparently into the urethra. Upon vaginal examination, the left base of the bladder felt indurated. Judging from the combined cystoscopic and bimanual examination, the growth seemed too extensive for radium implantation. Total cystectomy was advised. June 27 the right ureter was implanted into the ascending colon. There was no obvious fault in the

technic, and the anastomosis appeared to be satisfactory. No urine, or at most only a very small amount, was passed by rectum. Six days after operation, there developed a severe pain in the region of the right kidney. The next day urine began to leak through the wound, and the pain was relieved. The patient's condition was excellent, and the urine which leaked out was clear. It seemed best to go ahead with the program and later return to the right kidney. July 8, the left ureter was put into the descending colon. On this side, in order to avoid tension, the ureter was brought through the posterior peritoneum, the colon rotated inwards over it, and the anastomosis made intraperitoneal. The result seemed very satisfactory. Ten days later the patient was passing a good amount of urine by rectum, and draining freely from the incision in the right flank. July 29 the bladder was removed. No enlarged glands were found in the iliac chain. The bladder contained a solid growth 2.5 cm. in diameter, extending through the posterior wall; the base of the tumor, outside the bladder, appeared to be covered with normal fat tissue. The tumor proved to be a lympho-sarcoma. For a week the patient did fairly well. She drained 40 ounces per day from the right side, and put out considerable fluid by rectum. The output from the bowel then began to diminish, and edema of the extremities appeared. August 7, one month after the left anastomosis, urine began to leak from the left incision. The patient appeared now better, now worse. She seemed mildly uremic, and was generally edematous. August 20 it seemed to me, and to a medical consultant, that the only chance lay in supplying adequate renal drainage. Bilateral nephrostomy was done. The right kidney, except for congestion, appeared in good condition. The left kidney was thinned, pale, sclerotic, surrounded by an abscess cavity which had been inadequately drained by the abdominal sinus. The patient seemed in fair condition the next morning; both kidneys drained some urine. Later in the day she became comatose and died.

I recite these distressing details because they serve to illustrate certain objections to this method of treatment. The

first objection lies in the element of uncertainty which attends a cystoscopic interpretation. Undoubtedly the fulguration which preceded my cystoscopic examination helped to confuse the picture. Had I known the growth was so definitely limited, I would have treated it by radium implantation. The misleading picture which one sometimes gets through the cystoscope must be allowed for, when one is weighing the arguments for and against any method of operation.

The second objection depends upon the unreliability of the uretero-enterostomy. If there is constriction of the ureter, trouble will follow. The intestine may shift, thereby kinking the ureter, or adhesions may bind it and occlude the lumen. To have such an anastomosis leak after functioning for one month is disheartening. Of the 16 uretero-enterostomies which I have reported, 7 failed, 9 succeeded.

I cannot believe that the difference in the measure of success attained in this series and that reported by Lower (2) in a series of 16 uretero-enterostomies is entirely a matter of faulty technic. Of his 16 cases, 13 were done for exstrophy of the bladder. In this condition, the ureters are in much better position for intestinal implantation than when they are normally placed. The patient with exstrophy, furthermore, is young, and even though he is in poor general condition, his powers of healing and of resistance to infection are probably better than those of older persons with malignant disease. This criticism in no way belittles the excellent results obtained by Lower. It simply serves to emphasize the difficulties which attend this method of diversion of the urine in cancer patients. From the fact that Lower employed it in only three cases of cancer of the bladder, which is a common condition, while he used it 13 times for a comparatively rare condition, shows that he himself appreciates these differences.

It seemed worth while to report these discouraging results and to try, by constructive criticism, to deduce some general principle which may be helpful. I feel that, except in rare cases, the operation of uretero-enterostomy furnishes a poor foundation for the later operation of cystectomy. If cystectomy

is to be done, let it be preceded by a method of kidney drainage which shall be certain and safe. Such a method is direct nephrostomy. With the improvement in the technic of the application of radium, and the striking success which has attended its use in an increasing number of cases, the indications for total cystectomy are becoming fewer. I am coming to believe that a cancer of the bladder which cannot be relieved by the use of radium is too far advanced for cystectomy. There may be some cases of widely disseminated, superficial growths in which this is not true; for those cases, total cystectomy may be performed. It should be preceded by nephrostomy, however, and not by uretero-enterostomy.

REFERENCES

(1) Smith, George Gilbert: Jour. Urol., August, 1921, vi, no. 2.
(2) Lower: Jour. Amer. Med. Assoc., April 28, 1923, lxxx, no. 17, p. 1200.

REPORT OF A CASE OF INTRAMURAL EPITHELIOMA OF THE BLADDER APPARENTLY CURED BY DEEP X-RAY THERAPY FOLLOWED BY SUPRAPUBIC PROSTATECTOMY AND RECOVERY

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CASE REPORT

W. F. L., white, male, aged seventy-seven. October 13, 1922.

Family history. Negative.

Chief complaint. Frequency and burning on urination, complete retention necessitating catheterization twice daily for past four weeks.

History of present illness. The onset began two years ago with acute retention and patient had to be catheterized for two weeks, but was then able to void. Has had frequency and some burning on urination ever since. In the past six months this has become more severe with marked tenesmus and dribbling of urine. Four weeks ago he had another attack of retention and has had to be catheterized twice daily ever since. He has passed bloody urine at times, especially after catheterization. He had a stroke of paralysis six months ago, affecting left arm only. This attack lasted ten days. Had fracture of right femur two years ago.

Physical examination. A well preserved man, rather fat and lame from shortening of right leg, due to fracture of femur two years ago. Head and neck: negative. Chest: soft systolic mitral murmur: Lungs: negative; Abdomen: negative, except pendulous and the bladder, when distended, feels like a large pear with nodular indurations in anterior wall, especially in the left side of the fundus. There is some tenderness on palpation over the bladder.

Genito-urinary. External genitals: negative. Prostate four or five times normal size per rectum. It is not indurated or nodular. Feels adenomatous. Cystoscopy was not done as I did not think it wise to subject him to the danger of infection and shock, especially as my diagnosis was inoperable carcinoma of the bladder and the best I could hope for was relief of pain and retention by suprapubic cystotomy. As he had been catheterized for two weeks, having the bladder completely emptied twice a day no preliminary catheter drainage was instituted, but under local anesthesia, suprapubic cystotomy was done the following morning.

He was given hyoscene gr. $\frac{1}{100}$ and morphine gr. $\frac{1}{4}$, one hour before operation and 1 per cent novocaine with adrenaline, 4 drops to the ounce, injected in the line of incision. When the bladder was reached the entire anterior wall, especially the upper left half, was found covered with a mass of hard nodules, varying in size from $\frac{1}{2}$ to 1 inch in diameter. I did a cystotomy and was surprised to find the bladder mucosa perfectly smooth and free from ulcerations or tumor projections on it. The nodules were embedded in the wall of the bladder and I excised one of them by splitting the serosa and peeling it out without injuring the mucosa, thus proving it to be entirely intramural. A large Pezzer suprapubic tube was held in place by a purse string suture in the bladder and the fascia and skin closed to the tube. The laboratory report on the nodule was basal celled epithelioma.

Having been disappointed in the results obtained by the use of radium in cases of malignant tumors of the bladder and prostate referred to other men, I determined to try deep X-ray therapy in this instance. He was therefore referred to Dr. W. S. Lawrence of Memphis, for this work. He was given his first treatment the eighth day after the cystotomy and five more in the next two and one-half months. A 200,000 volt machine was used, distance of 50 cc., 0.5 mm. copper filtration and 1 mm. aluminum. Each treatment 300 milliampere minutes. After the fifth treatment, no nodular enlargements could be felt on palpation with one finger in the suprapubic opening and

the hand on the abdomen over the bladder, but there was decided thickening of all the intervening tissues. He was anxious to complete his operation and when I explained his case to his family, frankly stating that although the nodules had disappeared no one could say whether the epithelioma had been completely eradicated or not, they asked that the prostate be removed.

On January, 3, 1923, under gas oxygen and synergistic analgesia, with novocaine in the line of incision and in the prostate, suprapubic prostatectomy was done. The anterior bladder wall was found to be very much thickened but no nodular induration could be felt.

A section of the anterior bladder wall (to the left of the incision as this was the portion mostly involved with epitheliomatous nodules) was removed and sent to the laboratory for examination. The report was: Fibrous tissue, no evidence of epithelioma. The prostate was easily enucleated and the laboratory report was adenoma.

He made an uneventful recovery and is now entirely well, wound completely closed, voiding naturally with perfect control and with no symptoms of return of his epithelioma.

Intramural epithelioma of the bladder must be a very rare condition as I have been unable to find a single case reported in the literature and I have had the help of the Surgeon General's Office, The American College of Surgeons, The American Institute of Medicine and the library of the University of Tennessee. McCallum's Pathology states that intramural epithelioma may occur, but gives no case report. The rarity of intramural epithelioma of the bladder, the apparent cure by deep X-ray therapy, the probability of cure made more certain by a negative pathological report on a section of the bladder wall after the X-ray treatments and the successful removal of the prostate in a patient seventy-seven years of age, who had previously had a paralytic stroke and his complete recovery, makes this case worthy of report.

THE SURGICAL TREATMENT OF CANCER OF THE PROSTATE

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In this paper we wish to record a few observations on the surgical treatment of the malignant prostate. For our own guidance, we have distributed cases of this nature among four classes, the distribution being dependent upon the suitability of each case for certain therapeutic measures. Class A consists of those cases which are suitable for total prostatectomy. In class B are placed the cases which are too advanced for total extirpation, in which partial perineal prostatectomy, plus the implantation of radium needles, may be done to advantage. Class C consists of men with obstruction, who cannot get along with a catheter, and in whom the growth has involved the trigone or has given rise to metastases. In them, permanent suprapubic drainage is instituted. In class D are placed all cases too advanced for surgery, who nevertheless are able to empty their bladders reasonably well, either naturally or with the help of a catheter.

The division of cases of prostatic carcinoma into these classes depends upon the general physical condition of the patient, the presence or absence of metastases in spine or pelvis, the extent of the growth as determined by rectal and by bimanual palpation, and the cystoscopic picture. It depends also to a considerable degree upon the personal views of the surgeon. Given the same data, operators differ in their disposition of borderline cases.

To our way of thinking, cases are suitable for total prostatectomy when there are no metastases demonstrable, when the prostate, although hard and nodular in the midline, shows a sulcus between its lateral lobes and the pelvic walls, and a soft

bladder base above, and when the cystoscope shows no irregularities or ulcerations of the trigone, or other evidence that the growth has involved the bladder proper. Induration of the seminal vesicles does not contraindicate this operation, provided the induration is limited to the vesicles and does not extend onto the adjacent pelvic wall. If the malignant infiltration of the prostate does obliterate the periprostatic sulcus—in other words, if it has broken through the capsule of Denonvillier, but has not involved the trigone, we place the patient in class B. Perineal removal of the obstruction at the bladder neck and implantation of radium needles into the shell of malignant tissue left behind will often give relief for several years.

When metastases are present, or when the growth appears in nodular form on the trigone and bladder base, it does not seem wise to attempt a perineal operation. The period of life is likely to be so short that the relief afforded, provided the patient survives, seems hardly worth the effort. The surgeon must estimate the probable duration of life of his patient, and be guided by his best judgment. We feel that if death is likely to occur within six months, operation should be avoided provided the patient can be made comfortable otherwise. If, on the other hand, it seems likely that he will live for a year, we believe that freeing the bladder neck will prove advantageous.

The selection of the type of treatment, whether operative or not, and if so, by what method, depends to a large degree upon the surgeon's familiarity with the various methods, and upon his confidence in the ability of any one method to produce beneficial results.

It is interesting to note that in 1921 Geraghty (Jour. Urol., January, 1922, vii, No. 1, p. 33) said that of approximately 450 cases of cancer of the prostate seen in the Urological Department of Johns Hopkins, 14 were submitted to the radical operation of Young, in which the seminal vesicles and the neck of the bladder were removed, and 7 to a total prostatectomy.

It is our belief that in a much larger percentage than this, a total prostatectomy, or prostatectomy and vesiculectomy, may be done to advantage. Cure will not be achieved in every

case, but according to our experience, the operation is less dangerous than partial prostatectomy plus radiation, and it gives an easier, shorter convalescence and at least as long an extension of life as the latter.

The results of partial prostatectomy (perineal) plus radiation, tabulated according to length of life, were as follows:

Case 1 lived 33 days; death due to carcinomatosis.

Case 2 lived 60 days; death due to bronchopneumonia.

Case 3 lived 4 months; death due to paraplegia caused by spinal metastasis, although X-ray before operation showed none.

Case 4 lived 7 months; death due to general carcinomatosis.

Case 5 was alive 16 months after operation, although local recurrence had developed and there was a metastasis in the sternum. Relief of symptoms for 14 months.

Case 6 alive and in good condition 22 months after operation. Some question of local recurrence now.

Case 7 not heard from.

Case 8 not heard from.

Within the past 14 months, 5 total prostatectomies have been done. The specimens all showed carcinoma. In all, the prostates were removed entire; in several, one or both vesicles were removed also. In every case, the prostate separated easily from the bladder neck, leaving in view the circular fibers of the internal sphincter. The circular opening into the bladder was sutured to the deep layer of the triangular ligament, thus bringing the internal sphincter directly against the posterior aspect of this structure.

The recoveries made by these cases were surprisingly rapid and satisfactory. To our astonishment, every one retained his urinary control to a high degree. Occasionally, upon sudden exertion, a drop or two of urine would escape. None had to wear a urinal or even a towel. Several developed some obstruction a few weeks after operation, but were completely relieved by a few dilatations.

The time elapsed since operation has been much too short to show what this operation is worth. So far as immediate results go, this group has done much better than the partial pros-

TABLE 1

	NAME	AGE	DATE OF OPERATION	OPERATION	RADIUM	DATE OF DISCHARGE	RESULTS
1	S. S.	70	4/ 2/21	Partial perineal prostatectomy	5 needles—5 mc. each 72 hours = 1800 mc. hours	4/24/21 (22 days)	Fecal fistula 12 days after operation. Incontinent when standing
2	J. E. S.	68	4/12/21	Partial perineal prostatectomy	5 needles—5 mc. each 68 hours = 1700 mc. hours	6/17/21 (65 days)	Died November 7, 1921, of cancer liver, stomach, etc.
3	C. P.	60	5/ 9/21	Partial perineal prostatectomy	6 needles, total 67 mc.	6/12/21 (Death 33 days postoperative)	Died. Edema of leg and scrotum. Septicemia
4	F .N. H.	62	7/29/21	Partial perineal prostatectomy	1 needle, 77 mc., 6.7 hours; 5 needles—5 mc. each, 47 hours; total 1625 mc. hours	8/24/21 (25 days)	May, 1923, General condition excellent. Lately has had some obstructive symptoms. Typical induration in midline of prostate
5	A. J.	76	8/22/21	Partial perineal prostatectomy	7 needles, total 66 mc., 33 hours = 2178 mc. hours	10/22/21 (Death 2 months postoperative)	Gradually failed. Died broncho-pneumonia
6	C. R.	67	9/17/21	Partial perineal prostatectomy	5 needles—5 mc. each 48 hours = 1200 mc. hours	11/13/21 (64 days)	Developed paraplegia from metastases in spine while in hospital. Died, December 11, 1921
7	P. B.	61	12/28/21	Partial perineal prostatectomy	4 needles—25 mc. each 24 hours = 2400 mc. hours	1/25/22 (27 days)	Did well until March, 1923. Since then has had local recurrence and metastasis in sternum

8	C. H.	70	6/29/22	Partial perineal prostatectomy	4 needles—12.5 mc. each 44 hours = 2200 mc. hours	8/17/22 (48 days)	Incontinent on standing
9	C. S.	67	3/14/22	Total perineal prostatectomy	5 needles—5 mc. each 23 hours = 575 mc. hours. (Inserted into vesicles and beneath trigone)	5/14/22 (60 days)	December, 1922, excellent condition. Cystoscopy—no evidence of cancer. One hard area in left vesicle
10	T. M.	55	5/24/22	Total perineal prostatectomy and vesiculectomy	No radium used	6/19/22 (25 days)	May, 1923, cystoscopy shows local recurrence. Comfortable until April 1923. Good control
11	J. R.	66	12/26/22	Total perineal prostatectomy	No radium used	1/18/23 (22 days)	Good control—no residuum. Urine clear
12	L. B.	63	12/ 5/23	Total perineal prostatectomy right vesicle removed	No radium used	1/28/23 (23 days)	Excellent result so far (May, 1923)
13	G. E. M.	60	2/ 7/23	Total perineal prostatectomy	No radium used	3/ 5/23 (28 days)	May 10, 1923, excellent result. Good control

tatectomies who were radiated. It must be conceded, however, that the latter were farther advanced cases to begin with. The rapidity of their recovery was also somewhat hindered by the local reaction to the radium. For months some of them had strangury, and passed pieces of slough.

Table 1 gives more of the details.

CONCLUSIONS

1. Total prostatectomy for carcinoma of the prostate is warranted whenever no metastases can be demonstrated, when the bladder shows no evidence of invasion, and when the growth appears to be confined within the capsule of the prostate. A moderate involvement of the vesicles does not contraindicate an attempt at complete removal of the growth.

2. This operation is attended by lower mortality and easier convalescence than partial prostatectomy plus radiation.

3. Following total prostatectomy, control of the urinary sphincter is at least 95 per cent efficient.

EPITHELIOMA OF THE PENIS[1]

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The purpose of this paper is to add to the literature a statistical study of 36 cases of epithelioma of the penis, seen and treated at the Memorial Hospital during the past four years.

The age of the patients at the time of onset ranged between fifteen and seventy-four years, with the decades divided as follows:

0 to 10 years.....	0 cases	40 to 50 years.....	19.0 per cent
10 to 20 years.....	2.7 per cent	50 to 60 years.....	30.0 per cent
20 to 30 years.....	2.7 per cent	60 to 70 years.....	19.0 per cent
30 to 40 years.....	19.0 per cent	70 to 80 years.....	5.0 per cent

Eighty-one per cent had been married, 19 per cent were single. Every type of occupation was represented.

As to race, 13.5 per cent were negroes, 86.5 per cent were white. No Jews appear in this series. The United States was claimed as the birth-place by 48 per cent, Ireland by 27 per cent, Italy by 11 per cent, the West Indies by 6 per cent, Scotland and Germany by 3 per cent, respectively.

Regarding previous venereal diseases, all disease was denied, and no positive signs were obtained in 39.5 per cent. Gonorrhea was admitted by 19 per cent, syphilis by 5 per cent, gonorrhea and syphilis by 5 per cent, and chanchroid by 3 per cent. All disease was denied, but positive signs of syphillis were present in 8 per cent, and no record respecting this question was found in 16 per cent.

[1] Read as the meeting of the American Urological Association, Rochester, Minnesota, May 21, 22, and 23, 1923.

CAUSE

The causes ascribed by the patients themselves were of some interest. Trauma was given as the exciting cause by 8 per cent. Of these 2 cases, or 5 per cent might merit consideration namely, "adhesion to a condom" and "injury during coitus." The third, "rubbing against the clothing" might well have occurred subsequent to the onset of the disease. One patient, or 3 per cent, traced his tumor to a congenitally retracted penis for the relief of which three operations had been performed.

Five per cent noticed a development from a venereal sore. Eleven said "tight foreskin," and the same number believed the epithelioma resulted from their circumcision. Fifty-seven per cent knew of no attributing cause.

The examining physician attributed the cause to phimosis, 76 per cent; syphilis, 13 per cent; no cause apparent, 5 per cent; no record, 5 per cent.

The cases possibly associated with syphilis consisted of 4 instances, in which typical gummata appeared on the shaft of the penis in patients obviously leutic. When the lesions failed to heal, in spite of thorough specific treatment, biopsy revealed carcinoma. In another patient, the chancre occurred on the glans beneath a tight prepuce. Soon after the administration of the first dose of arsphenamine, paraphimosis appeared, and circumcision uncovered a neoplasm.

In 3 cases, or 8 per cent, beneath a tight prepuce there was a well defined area of leukoplakia, surmounting, and in each instance surrounded by carcinomatous infiltration. The leukoplakial patch was white, glazed and horny, and the patients stated that from time to time scaling of the surface took place. According to the histories, the leukoplakia was observed several years before any hardness or ulceration suggested malignancy.

The close relationship between phimosis and carcinoma of the penis has long been recognized. It is extremely rare to encounter this lesion in Hebrews. Another example of the prophylactic efficiency of circumcision is found in the report of Sutherland in which a statistical study is made concerning the prevalence of malignant disease at the Mayo Hospital, Lahore, India.

A glance at the result of the race analysis shows a more or less equal prevalence of malignant disease among the two peoples (Hindus and Mohammedans) with one important exception. This exception is in the case of carcinoma, where the Hindu admissions exceed the Mohammedan by 80, a difference almost entirely due to 72 cases of epithelioma of the penis among Hindus, an affection from which Mohammedans (who practise circumcision) rarely suffer (Arch. of the Middlesex Hospital, vol. iii).

When as the result of a prepuce difficult or impossible to retract, there is added the irritation of retained inspissated smegma, the circumstances are ideal for the development of penis cancer.

SYMPTOMS

The first symptom in 54 per cent of the cases, was a small sore on the penis; 14 per cent felt a lump beneath a tight prepuce; 8 per cent first noticed a wart; 8 per cent that their circumcision did not heal, and 5 per cent were circumcised, an epithelioma being revealed. Evidently in these last two divisions, comprising 13 per cent, the tumor was present before operation. Three per cent first noticed a progressive enlargement of both penis and scrotum; 3 per cent, a Negro, saw a reddish discoloration of the skin. One of the leukoplakia cases (3 per cent) was first aware of a "white scab on the glans penis, which would scale off, and break down, and then heal." Soon the cycle would be repeated.

Thus it may be noted that in practically all of the cases, even though phimosis and chronic balanitis had been present for years, a condition appeared which was recognized by all as something decidedly different, though its nature was not appreciated. Moreover, in every case, even though a condition of irritation had been present for a long time, the area of true epithelioma was quite small when it was first noticed.

After the appearance of the new growth, certain events followed which in 81 per cent of the cases consisted in a progressive enlargement of the lesion. Other symptoms in the order of their frequency were the following: Pain, 58 per cent (aching,

22 per cent; stinging, 14 per cent; sharp and burning, 11 per cent; itching, 11 per cent) purulent discharge, 8 per cent; paraphimosis, 5 per cent; bleeding, 5 per cent; obstruction to urethra, 5 per cent; frequency of urination, 3 per cent. Occasionally the same patient had a combination of these symptoms but the usual story was that a sore appeared which steadily increased in size, and soon became painful.

INITIAL TREATMENT

Since the possibilities of relief or cure of carcinoma depend so much upon early treatment, a record was kept of this factor. 8 per cent of the patients sought advice immediately. In 22 per cent of the cases there was either no record, or the patients had forgotten. In the remaining, or 70 per cent, a delay occurred of between two weeks and nine years, five months, or an average of 14 months plus, before treatment was sought.

The therapy employed after advice had been obtained, was as follows: "Washes, salves, dusting powders, local applications" 39 per cent; radical amputation, 14 per cent; local amputation, 8 per cent; radium and X-ray, 8 per cent; antileutic, 8 per cent; "caustic, electric treatments, cautery, fulguration, circumcision," 3 per cent each, or 18 per cent; 16 per cent were immediately referred to the Memorial Hospital.

While these various lines of therapy were being pursued, an average of forty-one weeks, or ten months per patient, elapsed. This was in addition to the fourteen months delay for which the patients were responsible. There was therefore an average elapsed period of twenty-four months from the beginning of the disease until the patient came to the Memorial Hospital.

EXAMINATION

In spite of these delays, our general physical examinations showed 84 per cent of patients to be in good conditions, 8 per cent to be classified as fair, and 8 per cent as poor.

There had been no loss of weight in 64 per cent of the cases, and amounts varying between trifling to 40 pounds in a year were reported in the remaining 36 per cent.

FIG. 1. CARCINOMA OF THE PENIS; PAPILLARY TYPE

FIG. 2. CARCINOMA OF THE PENIS; INDURATED ULCER TYPE

FIG. 3. SUPERFICIAL CARCINOMA

FIG. 4. SAME AS FIGURE 3; SIX MONTHS AFTER A SURFACE APPLICATION OF 60 MC. PER SQUARE CENTIMETER

FIG. 5. PAPILLARY TYPE OF CARCINOMA OF THE PENIS

FIG. 6. INFILTRATING TYPE OF CARCINOMA OF THE PENIS

FIG. 7. SUPERFICIAL CARCINOMA OF THE PENIS

A complete and permanent regression should follow the administration of surface radiation in these cases.

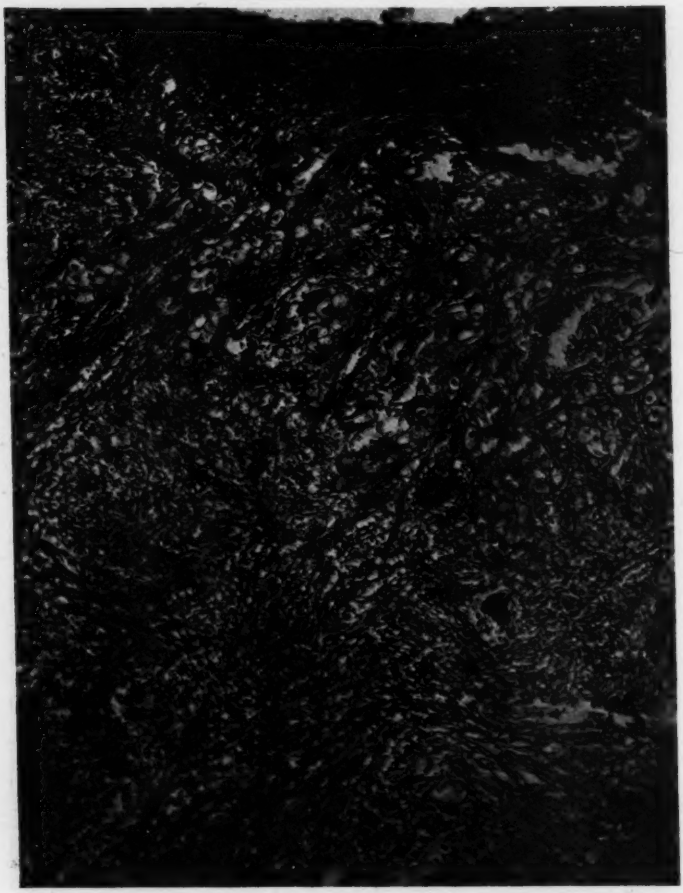

FIG. 8. THE EARLIER DEGENERATIVE CHANGES OF THE TUMOR CELLS FOLLOWING SURFACE RADIATION

Likewise, 64 per cent of the patients were unable to work, 36 per cent were following their usual occupations.

Considering the type of lesion, 56 per cent were indurated ulcers, 36 per cent were papillary, while 8 per cent were not recorded.

In respect to size, 10 were 5 sq. cm. or less, (27 per cent; 3 were 10 to 15 sq. cm. (8 per cent); 8 were 15 to 20 sq. cm. (22 per cent); 13 were 20 sq. cm. plus (36 per cent); not recorded 2– (5 per cent). The development of some of these tumors was remarkable. Perhaps the largest was described as the "size of a baseball," involving the distal three-fourths of the penis; it covered 40 sq. cm.

Two interesting considerations were mentioned by Barney, namely, the location of the lesion, and its point of origin. In our series it was quite impossible to obtain data for classification. The reason for this was that of the 36 cases considered, 22 different locations were described, and 17 points of origin were mentioned. In general, however, most of the lesions were first observed at some point on the glans penis, and increase in size was associated with involvement of contiguous parts of the organ.

INGUINAL ADENOPATHY

In 12 (33 per cent) the inguinal nodes were thought infectious. In 11 (30 per cent) carcinomatous; no enlargement, 2 (5 per cent); questionable, 3 (8 per cent); no record, 3 (8 per cent).

PATHOLOGY

Before undertaking the consideration of the therapy of this series, it might be well to consider the pathology involved, since it must be the basis of our treatment.

Two clinical types of carcinoma of the penis are described, namely, the papillary or cauliflower, and the indurated ulcer. The former is usually mentioned as being the more common, but in this series the latter type predominated to the degree of 60 per cent over 40 per cent. The most frequent site of origin is the glans, next in frequency is the mucosa of the prepuce.

The earliest signs of the two are different. The papillary type begins in a group of wart-like excresences. These increase

CASE NUMBER	TYPE	SIZE	PATHOLOGY	ESTIMATE OF INGUINAL
		sp. cm.		
29956	Papillary	30.0	Epidermoid carcinoma	Inflammatory hyperplasia
29662	Indurated ulcer	0.5	No biopsy	No adenopathy
3	Indurated ulcer	3.0	No biopsy	No record
30422	Papillary	30.0	Epithelioma	Inflammatory hyperplasia
5	Indurated ulcer	4.0	No biopsy	Questionable
6	Indurated ulcer	30.0	Infiltrating epidermoid carcinoma	No record
26739	Indurated ulcer	3.0	No biopsy	No record
28736	Papillary	40.0	Epithelial papilloma	Inflammatory hyperplasia
30190	Papillary	24.0	Infiltrating squamous carcinoma	Inflammatory hyperplasia
10	Papillary	25.0	Squamous carcinoma	Metastatic carcinoma (Mx)
28653	Papillary	15.0	Epithelial papilloma	Epithelial papilloma
29192	Indurated ulcer	20.0	Epidermoid carcinoma	Inflammatory hyperplasia
28617	Indurated ulcer	4.0	Squamous carcinoma	Metastatic carcinoma
29852	Indurated ulcer	4.0	Epidermoid carcinoma	Inflammatory hyperplasia
28480	Papillary	12.5	Squamous carcinoma	Inflammatory hyperplasia
16	Not known	Not known	Epithelioma	Epithelioma (Mx)
29644	Papillary	3.5	Papillary epithelioma	Metastatic carcinoma
18	Indurated ulcer	2.0	No biopsy	No adenopathy
31274	Indurated ulcer	3.5	Infiltrating squamous carcinoma	Inflammatory hyperplasia
31202	Indurated ulcer	40.0	Infiltrating epidermoid carcinoma	Metastatic carcinoma
29261	Indurated ulcer	20.0	Squamous carcinoma	Inflammatory hyperplasia
28529	Indurated ulcer	40.0	Epidermoid carcinoma	Inflammatory hyperplasia
23	Papillary	21.0	Epithelial papilloma	Inflammatory hyperplasia
28325	Papillary	18.0	Specimen lost	Metastatic carcinoma
30628	Papillary	11.0	Epidermoid carcinoma	Inflammatory hyperplasia
30552	Indurated ulcer	40.0	Squamous carcinoma	Metastatic carcinoma
27	Not known	20.0	Carcinoma (B.H.)	Metastatic carcinoma
31280	Indurated ulcer	19.0	No biopsy	Metastatic carcinoma
29	Not known	Not known	Carcinoma	Metastatic carcinoma
30	Papillary	20.0	Carcinoma (B.H.)	Metastatic carcinoma
31	Indurated ulcer	28.0	Epidermoid carcinoma	No record
28259	Papillary	30.0	Squamous carcinoma	Inflammatory hyperplasia
27266	Indurated ulcer	20.0	No biopsy	Metastatic carcinoma (Mx)
34	Indurated ulcer	4.0	No biopsy	Metastatic carcinoma (Mx)
28567	Indurated ulcer	30.0	Squamous carcinoma	Metastatic carcinoma
26597	Indurated ulcer	20.0	No biopsy	Metastatic carcinoma

in number, gradually spreading over a larger surface, and at the same time becoming more elongated. Parts of the tumor break down, forming areas of ulceration, and occasionally

bleeding may be an obtrusive symptom. This type has a tendency to remain localized. The dense protective tunic of

ENT OF PENIS	TREATMENT OF INGUINAL NODES	RESULTS	DIED
2. Amputation	X-ray	No disease, 16 months	
	X-ray	No disease, 12 months	
	Not treated	No disease, 27 months	
2. Amputation	X-ray	No disease, 8 months	
	Not treated		3 months; cause unknown
	Not treated	Seen once; unknown	
2. Amputation	Not treated	No disease, 39 months	
2. Amputation	X-ray	No disease, 12 months	
2. Amputation	X-ray		12 months; senility
ion. 2. X-ray	1. Removal. 2. X-ray	No disease, 14 months	
2. Amputation	1. X-ray. 2. Removal		21 days; tubercular; pneumonia
2. Amputation	1. X-ray. 2. Removal	No disease, 21 months	
2. Amputation	1. Radium. 2. Removal X-ray	No disease, 13 months	8 days; sepsis
2. Amputation	1. X-ray. 2. Radium	No disease, 8 months	
ion. 2. X-ray	1. Removal. 2. X-ray	No disease, 35 months	
2. Amputation	1. X-ray. 2. Removal	No disease, 31 months	
	Not treated	Improved; under treatment	
2. Amputation	X-ray	No disease, 18 months	
ion. 2. X-ray	1. X-ray. 2. Radium. 3. Removal		Dying of recurrence
ion. 2. Radium	X-ray	Not known	
2. Amputation	Not treated		8 days; uremia
	X-ray	Refused operation; only temporary improvement	
2. Amputation	1. X-ray. 2. Removal 3. X-ray	No disease, 22 months	
2. Amputation	X-ray	No disease, 7 months	
	X-ray	Under treatment	
ion. 2. X-ray	X-ray	No disease, 43 months	
	X-ray	Under treatment	
ion. 2. X-ray	X-ray	Not known	
ion. 2. X-ray	1. Removal. 2. X-ray	Not known	
	Not treated	Refused operation	Not known
	Radium pack	Not benefited; refused further treatment	Dead
	X-ray	Extension into bladder	8 days after cystotomy
	X-ray		38 months
2. Dorsal slit	Radium pack		3 months uremia
	Radium		10 months

the glans penis is a firm barrier to the extension of the disease. Once this has been pierced, and the loose cavernous tissue involved, the progression of the disease is much more rapid.

The infiltrating ulcer first appears as a superficial pink pimple, with a tiny ulcerating crater. The area of ulceration increases in size, and after a time infiltration advances, and finally, as with the papillary type, the tunic covering the glans penis is penetrated, and progress from thence on is more rapid.

Metastasis probably occurs by embolism through the lymph channels, and permeation along lymph vessels represents a later stage. The metastases may be either by way of deep lymphatics which accompany the dorsal artery and vein, and join pelvic nodes, or through superficial vessels to the inguinal nodes. This latter group of lymph nodes usually (80 per cent) shows enlargement and increased density, but is not necessarily involved with carcinoma. The necrosis and secondary infection of the penis lesion is an adequate cause in most instances for extensive regional adenopathy. Sometimes in the earlier, or less infected cases the inguinal enlargement is unilateral and corresponds with the side of the penis affected with the epithelioma.

Diagnosing the presence or absence of carcinoma in enlarged inguinal nodes is extremely difficult, and often impossible, and many times our type of therapy is based almost entirely upon the opinion respecting this factor. The status of the deeper pelvic nodes can rarely be learned, but fortunately this is of lesser importance, because the inguinal metastases occur relatively much earlier in most cases. It has appeared noteworthy in this series that metastasis in general has occurred relatively rather late in the disease. In fact, in several instances the organ was almost entirely destroyed without any microscopic evidence of malignant involvement of the removed inguinal nodes. The papillary type of tumor seems to be the less dangerous in this respect.

TREATMENT

1. For the papillary carcinoma, without induration of its base, and without penetration of the tunic of the glans penis, surface radiation with radium is apparently the method of choice.

2. If there is induration and some penetration of the tunic of the glans, and but slight extension along the penis, implanted radium *may* cure.

3. If there is extensive involvement of the glans penis, local amputation, 2.5 cm. beyond the growth is indicated.

INGUINAL LYMPH NODES

Most of the lymphatics of the penis drain into the lymph nodes of the inguinal region, and in early cases of carcinoma of the penis, a careful and complete bilateral block dissection of the inguinal nodes ought theoretically to limit the extension of the carcinoma. The problem is, however, not as simple as this. The following are various phases of the question of what to do with these nodes. Barney says: "Glandular enlargement occurs in 75 per cent. Forty per cent are hypertrophic, and 60 per cent carcinomatous." In other words, in 45 out of every 100 cases of carcinoma of the penis, the inguinal nodes are carcinomatous. Yet in 74 primary cases, amputation alone was performed in 46, and groin dissection in but 16. The totally cured cases were 27, or 36.5 per cent, probably indicating that 45 per cent is too high an estimate of inguinal involvement.

Broders finds that 100 per cent of patients with metastases who had lesions of the penis obtained poor results; 63.63 per cent of patients without metastases obtained good results, and yet further down, "100 per cent of the patients in whom no inguinal lymph nodes were removed obtained poor results." Others have said that if the lymph nodes were carcinomatous, dissection of these is bound to be incomplete, and will result in local recurrence at the site of the operation.

Streptococcic infection of the inguinal nodes is fairly common. A tight foreskin harboring a carcinoma is impossible to keep clean, and is the source of this infection. If, in addition to a streptococcic infection, the inguinal nodes are carcinomatous, a combination is formed almost impossible to cope with. The infection has to be overcome before the nodes can be touched, and the only way to overcome this is to first deal with the source of infection in the penis. There is a certain mortality attached

to the dissection of the inguinal nodes. We have lost 2 cases in old persons, in 1 of which the nodes were not carcinomatous, from infection of the wound.

Quick ("Conservative treatment of cervical lymphatics in intraoral carcinoma," Journal of the American Medical Association, August 6, 1921) respecting the treatment of intra-oral carcinoma, similar in many ways to penile carcinoma, says that many unnecessary operations will be performed if a blanket rule of block dissection be followed in all cases, and the operable mortality will certainly rise. He deals with the nodes of the neck conservatively, only dissecting them out when they become palpable, then burying radium tubes along the chains of cut lymphatics.

Ewing's work forms the basis of Quick's conclusions. The following is therefore the procedure which, in the light of our present knowledge, we believe is the best way to deal with the inguinal lymphatics.

1. If no nodes are palpable, the groins are given X-radiation and watched.

2. If nodes are palpable, but thought to be only infectious, the primary focus in the penis is treated, and the groins radiated and watched.

3. If the nodes are carcinomatous, and this diagnosis hard to make, they are radiated, and then bilateral dissection done with radium buried along the lymph channels, either in the form of bare tubes or screened radium, the most important place to radiate being the lymph channels around the saphenous opening.

4. If the nodes are thought to be infected, and carcinomatous, the lesion on the penis is dealt with, and the source of the infection cleared up before the inguinal nodes are touched.

5. If the nodes are dissected out, the wound is partly sutured, and Dakin tubes left in place, so that the Dakin irrigation may be employed until granulation occurs.

RESULTS

These are best shown by dividing our cases into 4 classes:

1. Those cases in which the inguinal nodes were not thought to be involved, and were not treated by radium or X-ray, 7

cases, in 2 of which the disease was proved by biopsy, and 5 no biopsy.

Radium application to the penis was the only treatment in 6 cases, and radium and amputation of the penis, in 1 case.

Of these 7, 1 died, one week post-operative after amputation of the penis, and 1, three months after radium treatment, cause unknown.

One disappeared after one treatment, 1 was lost track of, and 1 is under treatment.

There were but 2 which have done well; 1 free from disease after radium for twenty-seven months, and 1 after radium and amputation after thirty-nine months. There was no biopsy in either of these cases, and both were small lesions.

2. Carcinoma of the penis, in which the inguinal nodes were thought not to be involved, but were treated by radium or X-ray, 12 cases.

Radium and amputation of penis was done in 8 cases.

Radium alone in 3 cases.

X-ray in 1 case.

One is dead, twelve months post-amputation, from senility. Three are under treatment, or not benefited, or result not known.

Five are disease free, six to twelve months. One was treated by radium alone, and 4 by radium and amputation. There was a biopsy in 4; 3 of these were malignant, and 1 was epithelial papilloma. The size of the tumors in this group varied from 4 to 40 sq. cm.

Three are disease free, twelve to twenty-four months, biopsy in all, the size of the tumors measured from 3.5 to 30 sq. cm.

3. Carcinoma of penis, in which inguinal nodes were thought to be malignant, but were only treated by radium or X-ray, 8 cases.

The mortality figures here rise. But 1 case—a carcinoma in which the entire glans was involved (20 sq. cm. plus) has gone forty-three months without recurrence. Four are dead, one died a week post-operative of uremia. The others lived three months; ten months and thirty-eight months, respectively after treatment. Three are no better, or are under treatment.

4. Carcinoma of penis, in which the inguinal nodes were thought to be involved, and were dissected out, 8 cases; 3 of these are well, twelve to twenty-four months, 2 of these are well, twenty-four to thirty-six months, 3 of these showed pathologically metastases in inguinal nodes.

The size of the primary tumor in these was, in sq. cm., 3.5, 18, 20, 25, respectively and 1 not known.

So, out of 36 cases, 16 are, as far as can be seen, disease free: 5, six to twelve months, 6, twelve to twenty-four months, 3, twenty-four to thirty-six months, 2, thirty-six to forty-eight months.

We can say nothing of the cure of these cases, as enough time has not elapsed.

SUMMARY

1. Both papillary and infiltrating carcinoma of the penis may be removed by radium, if the tunic covering the glans penis has not been penetrated.

2. After penetration of the tunic surgical removal 2.5 cm. proximal to the growth is indicated.

3. Metastasis probably occurs by embolism through the lymph channels, and is usually noted earliest in the inguinal nodes.

4. From existing statistics, it is probable that inguinal involvement by carcinoma is relatively late, and occurs in rather less than 40 per cent of cases.

5. We believe that the best results are obtained by conservative treatment of the inguinal nodes, with routine X-ray of all cases, witholding surgical removal, until they are believed to be definitely carcinomatous. Then, after removal, the lymph channels should be radiated.

6. No surgery should be done on the inguinal nodes, if they are the site of a pyogenic infection. The source of such infection, the penis, should be dealt with first.

RATIONAL CLASSIFICATION OF BLADDER TUMORS

B. S. BARRINGER

The following is a working suggestion that may result in some coördination in the reporting of bladder tumors. End results of surgery, radium, fulguration, or any combination of these are impossible of interpretation if there is any confusion as to what kind of tumor has been dealt with.

In table 1a, value is given to various physical findings. It may be possible that such a valuation is impracticable. On the other hand, the use of this, or some similar table may serve to call our attention to various points in tumor morphology or pathology, and enable one more readily to classify any given tumor.

In the table, the principal features of different tumors are indicated by plus signs. The one sure proof of the nature of a tumor is a pathological examination of a section of the tumor, and the adjacent bladder wall (marked on chart 100 per cent). Without this examination, a tumor may be said to be "80 or 90 per cent probable."

We are at the present day destroying many growths by radium or fulguration through the cystoscope. In these it is sometimes impracticable to get a piece of the tumor with the adjacent bladder wall. Such cases should not be thrown out of our reports, but reported rather as lacking pathological proof.

In reporting the results of operation or radium treatment, of tumor growths, it would seem best to describe the position of the tumor in the bladder, its relation to the ureter, trigone, or internal urethra, and its size, rather than to classify the growth as operable or inoperable. Cystoscopic examination should be the proof of the removal of the tumor, but if such examination be impracticable, then the report of the time elapsed since operation, and the condition of the patient reported.

In an effort to obtain the pathologists' point of view, with reference to various confusing points, five pathologists were

TABLE 1

Bladder tumors; value of physical findings

	PAPILLOMA	PAPILLARY CARCINOMA	INFILTRATING CARCINOMA
Cystoscopy:			
Pedunculated	+		
Sessile		+	+
Multiple	+		
Red	+		
Slough		+	+
Rectal:			
Induration			+
Open operation:*			
Pedunculated	+		
Sessile		+	+
Multiple	+		
Red	+		
Slough		+	+
Induration			+
Pathology:†			
Piece of top	+	+	+
Entire tumor or piece with adjacent bladder	100 per cent	100 per cent	100 per cent

* If open operation, cystoscopic and rectal examination disregarded.
† If entire tumor or piece with bladder, all above disregarded.

consulted. Three were willing to give a valuation on a percentage basis of various points in the diagnosis of malignancy. These are:

Dr. A. 1. Solidity of growth, 10 per cent.
2. Fixation of base, 40 per cent.
3. Atypical qualities of cells, 50 per cent.
4. Loss of polarity of cells, 80 per cent.
5. Heterotpia of cells and infiltration, 100 per cent.

Dr. B. 1. Infiltration, 100 per cent.
2. Atypical cells with atypical arrangements of mitoses, 60 to 90 per cent.

Dr. C. 1. Infiltration, 100 per cent.
2. Atypical cells, mitoses, etc., 20 per cent.

Of course, infiltration implies that some position of the bladder wall adjacent to the tumor be shown in the slide. It is interesting that all give 100 per cent to infiltration, but variations between

FIG. 1. PAPILLOMA

20 and 90 per cent are given to atypical cells, and atypical arrangement of cells.

Two pathologists believed that any percentage basis of malignancy would achieve no useful end. While I did not ask the question directly, there seemed a fair consensus that the simpler

the classification, the better, and to this end the three types, papilloma, papillary carcinoma, and infiltrating carcinoma, for the common types of bladder tumors, seem satisfactory. This, of course, does not include the less common types, adeno-carcinoma, mucus-carcinoma, etc.

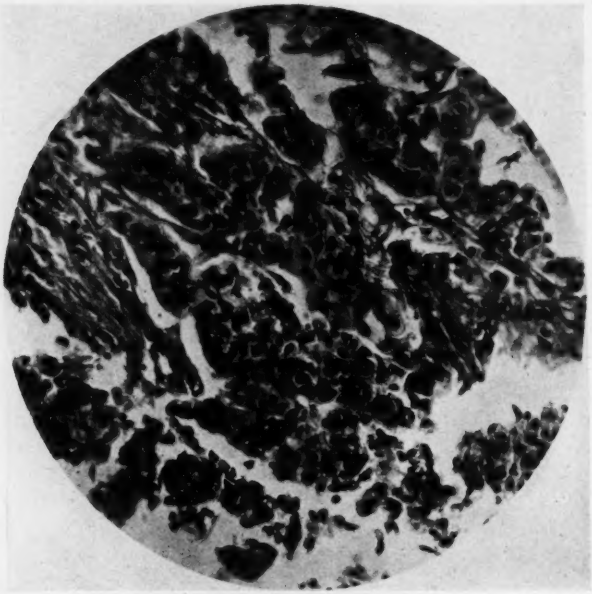

FIG. 2. PAPILLARY CARCINOMA

One of the pathologists believed that there was a definite place for the classification "malignant papilloma," a type between papilloma and papillary carcinoma.

My impression is, that if the same slide were submitted for diagnosis to each of these pathologists, the diagnosis would be pretty uniform. One of the them made the suggestion that in a local way, several near clinics might have a travelling library of slides, with the diagnoses side by side of the several pathologists. This may prove to be the one feasible way to settle the question.

Certainly a five years' survey of such a library with end results, would give us some idea of what tumors are malignant and what are not.

One of the pathologists very kindly gave me typical examples of each of these three classes of tumors, of which I obtained microphotographs.

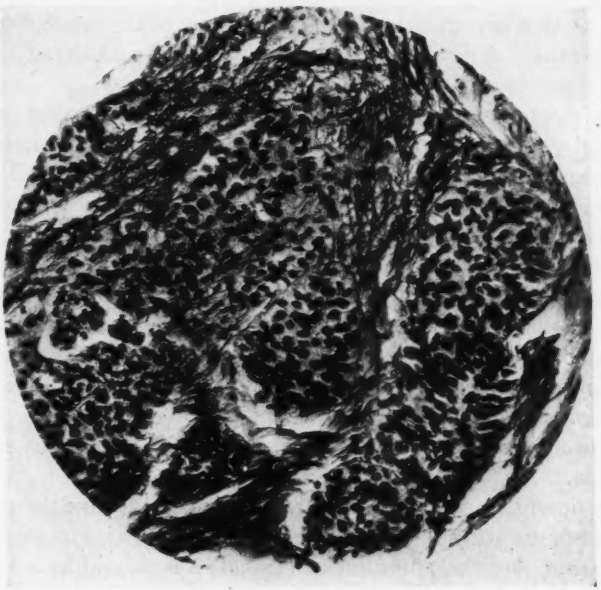

FIG. 3. INFILTRATING CARCINOMA

These suggestions are presented with the belief that our Association might properly and profitably make a serious attempt to standardize the diagnosis of bladder tumors.

DISCUSSION

Dr. Hugh H. Young (Baltimore): Dr. Smith has presented a very interesting paper, bringing out a great many important points. One in particular is that carcinoma of the prostate should be operated, and while I have always been considered radical, he is even worse.

We started a number of years ago with cases that seemed operable, excising as much of the prostate as seemed necessary and one vesicle and leaving the vesicle neck intact, as well as the trigone and the urethral sphincter. We got recurrences, and after studying the pathology more fully we felt that an operation that did not include the trigone was inadequate. Suppose this is the trigone (illustrating on blackboard), we found by studying the pathology that the carcinoma, as it moved upward, involved the musculature of the trigone but rarely broke through the mucous membrane. Going on upward it invaded the seminal vesicles. It therefore seemed evident that in order to do a radical operation it was necessary to take as much of the trigone as possible.

The operation employed by Dr. Smith does not take the portion of the musculature of the bladder which is early involved by the carcinoma, and therefore not as radical as it should be. It is an easy matter when you excise the neck and trigone of the bladder to draw the interior wall down and suture it to the stump of the bulbous urethra and get a good result. If you observe the fascia that surrounds the prostrate anteriority and go between the fascia and the prostate, you not only preserve the blood supply and the nerves to the triangular ligament and spinchter, but get perfectly good urinary control. It is not necessary to do this partial subtotal operation. As a matter of fact, in our experience stricture may occur after the partial or subtotal operation, and sounds have to be passed to prevent stricture formation, and certainly you do not do as radical a procedure. We are dealing with a

malignant condition, and why not be as radical as we can? A study of ultimate results which I made for the last edition of Cabot's Surgery showed about 73 per cent of apparent cures in 19 cases that we followed over three years. I do not believe that is quite accurate, because I saw with Doctor Crowell yesterday, a case we operated four years ago, and he has a recurrence. But I believe it shows that you do get a good percentage of cures—comparable with carcinoma of the breast.

But I do not agree with Dr. Smith in thinking so many are operable. For instance, where the carcinoma involves both seminal vesicles and pretty well up to the tip, it is generally useless to try to do anything radical. We now confine operation to those cases in which the lower portion of the seminal vesicles is involved.

From a surgical standpoint the operation is not very difficult and the immediate results are most satisfactory. Not a single one of the 19 cases has resulted in stricture. Therefore I want to oppose this tendency, on account of fear of incontinuence and the difficulty of operation, to do less radical operations. In the surgery of malignant disease, we ought to be as radical as possible.

I think it is a great pity that Dr. Livermore did not show his slide of that specimen. His case was certainly one of the most remarkable I have ever heard of. If this intramural epithelium of the bladder was covered with smooth mucous membrane, I would like him to tell us from what surface it probably sprang.

Dr. Barringer did not tell us the treatment he used and the results, and that is the thing we are interested in. When he closes the discussion I would be glad to have him give us more of the details. It seems to me that Dr. Barringer secured better results where he removed the inguinal glands surgically than where he used radium. I would like to ask him, where he has a case with more or less destruction of tissue, if he does not think surgery is better than radium. Personally, I feel that radium does not give results in carcinoma of the penis.

Dr. Alexander Randall (Philadelphia) Apropos of Dr. Barringer's paper I wish to enter a word of warning. As a

sequence to my work on granuloma, a large number of cases of chronic senile lesions have been referred to me; many typical carcinomas hoping for the possible chance that they were granulomas; others called granulomas that were proven carcinomas; and a few considered carcinomas that have been proven granulomas. The border-line is very indistinct. Two of our first series of granulomas had been diagnosed epithelioma from tissue sections, and we soon learned that the epithelial edge of a granuloma shows marked proliferative changes easily mistaken for malignancy. I have not seen a case of true granuloma in the white, but those who have good-sized negro population to deal with must always look with questioning eyes on any proliferative growth on the penis in the negro. The therapeutic test is simple because in a case of true granuloma three of four injections of tartar emetic will show immediate evidence of healing. So in the border-line cases it is certainly advisable to give them first this therapeutic test.

Dr. Francis Hagner (Washington, D. C.): Some years ago I reported a case of intramural adenoma of the bladder which was attached to the top of the bladder. Doctor Welch saw the specimen and suggested that it arose in the urachus. We did not find the growth with the cystoscope, but when we opened the bladder for removal of the prostate the growth was found, removed, and the pedicle tied off.

Dr. George Gilbert Smith (closing): I appreciate very much Dr. Young's discussion of my attitude in regard to carcinoma of the prostate and I shall certainly keep his suggestion in mind. It seems to me the situation is this—when you have a man who cannot empty his bladder because he has carcinoma of the prostate and you have to do something for him, it is much better to free his bladder neck if you have a reasonable chance to give him a period of rest, even if it is only for two or three years, and not pass him up because you think you cannot get a complete cure. My chief reason for writing about this very small series of cases was to show that in my experience the convalescence and the end

results were rather better with the subtotal prostatectomy than with the partial prostatectomy plus the implantation of radium. I think Dr. Young is right, that if there is any chance of getting a complete cure by a more radical operation, it should be done. I appreciate very much his criticism.

DR. GEORGE R. LIVERMORE (closing): I have no suggestion to offer as to the way this epithelioma developed, except perhaps that it might have been some embryological misplacement of cells, probably from the urachus, as Dr. Hagner mentioned in his case. I could get the slides in time for this meeting, but I hope to have them to publish with the paper in the Transactions.

DR. BENJAMIN S. BARRINGER (closing): In the diagnosis of carcinoma of the bladder we have found the cystogram a great help in placing the tumor and determining the size. I am interested to hear him tell of the good results of radium.

Dr. Livermore's experience is interesting. I think most of us feel it is rather an atypical tumor of the bladder, and I think these occasional tumors may react to deep X-ray therapy. My experience has been that deep X-ray therapy does not do much for bladder carcinoma. In 1 case subjected to deep X-ray therapy, the tumor from month to month could be seen to grow larger.

I cannot help but say a word on carcinoma of the prostate, and that is that I am distinctly opposed to as much surgery as we have heard mentioned. This is one of the most malignant tumors there is in the human body, and if Dr. Young watches his cases ten years, most of them will probably die of carcinoma. In the advanced cases, if their time to live will perhaps be one to three years, why should they be subjected to a major operation from which it will take them six months to recover? I think Dr. Smith's cases prove that. Of the 8 cases having a partial prostatectomy and radium, but 2 lived any appreciable time. Why not let these people die in peace if they are bound to die anyway? I believe you can do as much with radium as with surgery, except where there is retention of urine.

I will read the results, which I omitted when reading my paper for lack of time.

DR. HUGH H. YOUNG: It seems to me that Dr. Barringer secured better results where he removed the inguinal glands surgically than where he used radium. I would like to ask him, where he has a case with more or less destruction of tissue, if he does not think surgery is better than radium. Personally, I feel that radium does not give results in carcinoma of the penis.

DR. BENJAMIN S. BARRINGER: I would like to quote Barney's statistics. In five years his best results were those cases in which simple amputation of the penis was done. We have taken out numbers of inguinal glands which were not carcinomatous. If they are carcinomatous, I believe better results can be obtained with radium assisted by surgery.

DR. HUGH H. YOUNG: If a man came to you with carcinoma of the glans penis—if he was a good friend of yours—how would you treat him?

DR. BENJAMIN S. BARRINGER: I believe I would treat him as I have outlined. If it was superficial, I would give him radium direct. If it had penetrated the head of the penis, radium would not do it; amputation of the penis must then be done. The treatment of inguinal glands is a different proposition.

OPERATIVE TECHNIC IN THE REMOVAL OF RENAL CALCULI

ARTHUR L. CHUTE

It is hardly possible to consider the operative technic employed in the removal of renal stones without considering to a slight degree the indication for the employment of the different types of operation. For this reason I have touched upon the indications for operation more perhaps than my title would seem to warrant. The operative technic that one employs in the removal of a renal stone has a two-fold purpose; it must remove the calculus that is immediately threatening the integrity of the kidney and must do this with the least danger to life and with the least damage to the renal tissue; it must also, in so far as it is possible, leave the kidney in the least favorable condition for the reformation of a stone, unfortunately not an unusual occurrence.

In some instances I believe it is quite impossible to combine the least risk to life and the least damage to the secreting tissue with the greatest probability of freedom from recurrence. It often becomes a question as to how far we are warranted in increasing the immediate operative risk and the destruction of renal tissue in our attempts to minimize the probability of the reformation of calculi; how much we are justified in sacrificing the present for the future. No hard and fast rule can be applied to this but each case must be decided on its own merits.

We have two general types of operation that we employ in the removal of renal stones, pyelolithotomy and nephrolithotomy. While nephrolithotomy is the operation of broadest applicability, pyelolithotomy has a very definite place and the operation to be selected in the individual case depends upon the type of stone with which one is dealing and the condition of the kidney pelvis. By the type of stone I do not mean its chemical composition so much as its size and shape. The condition of the kidney

pelvis has reference to the degree of dilatation present and whether or not there is infection; both of these are important factors in selecting the type of operation especially applicable to the case in point.

A small stone in an uninfected kidney pelvis seems to me to be the one type of stone in which pyelolithotomy is clearly indicated; in instances where a stone is relatively small but the kidney pelvis moderately distended, even though it is uninfected, I believe the indication for pyelolithotomy becomes less clear.

In pyelolithotomy the kidney is exposed by the usual loin incision, separated from its perirenal bed, and lifted as high as possible into or even onto the loin. The pelvis is palpated and if a stone is felt, it is held in position while a longitudinal incision, $\frac{1}{2}$ to $\frac{3}{4}$ inch long, is made in the posterior surface of the pelvis on to it. It is naturally desirable to avoid in this incision any vessels that are evident on the surface of the pelvis. Unless the kidney can be brought well into the incision I find it helpful to put a guide suture into the pelvis on either side of the proposed line of incision. An incision having been made directly onto a stone, it is, as a rule, easy to remove it with forceps or to work it out by prying with the point of a director or a blunt dissector.

If on opening the kidney pelvis, the stone cannot be felt, one retracts the edge of the incision and introduces a curved forceps, director or probe, into the pelvis, and with the kidney held in the operator's left hand, one proceeds to search the intrarenal part of the pelvis and the calyces. If a loose stone is discovered in the pelvis or even in a calyx, it may be seized by forceps and easily removed in most cases. A slightly branched stone may be caught with the forceps and carefully worked free and removed in some cases. In the case of a stone that is loose in a dilated, intrarenal part of the pelvis but is too large to be removed through an incision confined to the pelvis, it is possible to increase the incision a little above by carrying it into the renal tissue at the hilum; this part of the incision should, however, be sutured especially carefully.

The ordinary pyelolithotomy wound should be closed with a line of interrupted sutures bringing the pelvic wall together; it is then wise to reinforce this line of sutures by covering it with a flap of fat or other surrounding tissue loosely caught down. The pelvic incision should not be closed, however, until one has made sure by the passage of a probe or ureter catheter that the ureter is not obstructed below. I have found it possible on a few occasions to open a kidney pelvis on its anterior surface. One has to be very careful, however, to avoid injury to the renal vessels, but in the occasional case this may be done.

It is rarely ever wise to place tube drainage in a pyelolithotomy wound since this is too often followed by a sinus. It is my custom to carry practically always a rubber wick down into the loin in all cases where I have mobilized a kidney, and I believe the perirenal space should be drained following the removal of renal stones, regardless of the method employed.

A deep lying kidney that cannot be mobilized makes pyelolithotomy difficult, sometimes impossible. A branched stone of any size, an infected kidney, or even a much dilated, uninfected kidney pelvis, are, I believe, contraindications to pyelolithotomy. As in any type of operation for a kidney stone, pyelolithotomy should be preceded by a very careful radiographic study of the patient, and the operation should be carried out with the radiograph at hand. The stone or stones removed at operation should be compared to see if they correspond with the shadows seen in the radiograph. It is not so very unusual to have the appearance of an irregular stone in the radiograph, and to find at the time of operation that it is made up or two or even three partially superimposed stones. Under these circumstances, unless one is very careful and sees that the stone removed conforms with the shadow in the radiograph, it may be possible to leave a stone behind. The presence of a facet, on what one supposed was a single stone, should lead to further search.

The only real danger of pyelolithotomy is, I believe, sepsis. I have seen even a fatal sepsis follow this operation. I have not encountered any serious hemorrhage in cases of pyelolith-

otomy; the urine is often bloody for a time, but I have no recollection of any hemorrhage that was at all disquieting.

Nephrolithotomy, while much more of an operative procedure than pyelolithotomy, has always seemed to me the operation best adapted to the treatment of most renal stones. A branched stone of any size is difficult, and sometimes almost impossible to remove through a pelvic incision. Any attempt to do this is apt to be followed by the breaking off and leaving of little bits that are sure to act as the nuclei for the reformation of stones. When there is a considerable dilatation of the kidney pelvis, with the stiffened and infected pelvic walls that so often accompany a stone of any size, adequate drainage offers, I believe, the best safeguard against the reformation of stones, in that it puts the pelvis at rest and gives it the best chance to free itself from infection and regain its muscular tone. A kidney pelvis, that following the removal of a stone contains a collection of stagnant, infected urine, is practically sure to become the seat of another stone. A large proportion of the patients that I see with renal stones present one or more of these characteristics, and I am convinced that nephrolithotomy is a better operation for them than pyelolithotomy. In a series of 50 operations for renal calculus that I looked up recently, I found that I had used nephrolithotomy much more frequently than pyelolithotomy. In fact I used pyelolithotomy alone in but 14 of these cases, while in 10 other cases in which I did a pyelolithotomy I was forced to add to it a cortical incision in some instances in order to get the calculus, making the operation a nephrolithotomy; in other cases, the cortical incision was added to give adequate drainage to dilated or infected kidney pelves.

In nephrolithotomy the affected kidney is exposed and freed from its bed of perirenal tissue as in pyelolithotomy. If it can be delivered into the incision or onto the loin, so much the better. The kidney is then palpated to locate the stone, if this is possible; often an area of increased density is all that will be found to indicate the stone's position. If nothing can be felt, the relation of the stone shadow to the general outline of the kidney, as seen in the plain radiograph, or the relation of the stone's

shadow to some part of the kidney pelvis, as shown by the pyelogram, should give some hint as to its probable location and the placing of the incision. The incision which in nephrolithotomy is usually from 2 to 3 inches long, though it may extend from pole to pole, is made in the cortex on its convexity, roughly ¼ inch behind the median line and parallel with its long axis, in the so-called anemic line. If the stone is large or if one's incision is fortunately placed, one comes down directly upon it: the incision is then dilated with a finger or enlarged to the necessary degree, the stone grasped with forceps and lifted out; if adherent, it will have to be worked free as carefully as possible. The length of the incision will have to depend upon the size of the stone. One must avoid, so far as possible, in his attempts to remove a stone the nibbling off of little bits with forceps, or the breaking off of little prongs of a branched "coral-shaped" stone; this cannot always be avoided but whenever it does occur, as an inspection of the removed stone will show, an attempt must be made to remove these bits; otherwise, they will act as nuclei for the formation of other stones. When one does not come upon a calculus directly, enlarging the wound sufficiently to allow the introduction of the finger into the pelvis will usually permit one to locate the stone.

It may upon occasion be all but impossible to find a small stone even through a nephrolithotomy incision. I have on two occasions that come to mind so injured a kidney in a fruitless search for a small stone that I felt it wise to do a nephrectomy. After the removal of the kidney it seemed hard to understand why I should not have been able to locate the stone which was in both these instances found in the lower calyx. I believe, however, it is far easier to overlook small stones in a pyelolithotomy than in a nephrolithotomy, in fact it is not unusual to have to add to a pyelolithotomy a nephrolithotomy in order to find a stone. I do not, however, now remember of having had to supplement a nephrolithotomy with an incision into the pelvis to find an elusive stone. After the removal of the calculus a ¼- or ⅜-inch rubber tube, with rather firm walls is carried down from the cortical incision into the kidney pelvis; the end is

notched but no lateral eye is used, since granulations often grow into this lateral eye and are pulled off at its removal, sometimes causing annoying bleeding. I do not fasten this tube to the kidney since it is held firmly enough by the sutures used to close the renal incision which are passed through the cortex on either side of the tube at intervals of from ½ to ¾ of an inch. For this purpose No. 2 chromic catgut is used, threaded into long, round-pointed, curved needles. It is important that these stitches be not tied too tight, since if they are they will cut into the renal tissue. Obstinate bleeding may require the use of a mattress stitch; this, however, is unusual and undesirable, as I believe it causes an increased injury to the secreting tissue.

It does not seem to me that any kidney which has been opened by incising the cortex should be closed without tube drainage. It has been my experience to see a number of cases in consultation, in which following the removal of a stone, closure of the kidney incision without drainage had been done, with the result that the bleeding had continued until it became necessary to open up the incision. In these cases there was clot in and about the kidney; clots protruded from the edges of the kidney incision, while the renal pelvis was also distended with clots. In these cases it was necessary to place a tube in the renal pelvis and close the renal incision again. A tube placed in the pelvis at the time of operation seems to act as a safety valve, taking care of the postoperative oozing and preventing the distension of the kidney with clot which in turn leads to still further bleeding.

Sometimes in nephrolithotomy when one attempts to cut through from the cortex to the kidney pelvis, especially in cases where the stone is small and the pelvis not dilated, it happens that one's incision goes right through into the renal sinus without opening the pelvis at all. This has not in my experience seemed to do any great harm but it is mortifying and undesirable. It can be prevented by first making an incision in the pelvis and introducing a curved instrument toward which one directs his renal incision.

When a kidney can be brought pretty well into the loin incision it is possible to have an assistant compress the pedicle, which diminishes the bleeding materially; this cannot be done very well with a kidney that is fixed. Sometimes the compressing hand is so much in the way as to be undesirable; even when no compression is used, the bleeding is rarely such as to cause alarm.

Needling a kidney for the purpose of locating a stone is a rather blind procedure that has always seemed to me unsurgical. I have rarely, if ever, employed it. I have been unable to see the advantage of incising a kidney by sawing through it with a wire introduced by a big, dull, curved needle. I can see in this no advantage over the use of a knife. I have not employed the fluoroscope at the time of operation. It has seemed to me of rather limited applicability. In cases where for any reason I fear a stone has been left I have the patient radiographed very shortly after operation. In one such case, not very long ago I went in and removed a third stone which I knew from the radiograph was present but which I had been unable to find at the time of operation.

About the only postoperative complication of nephrolithotomy is hemorrhage. On two occasions nephrolithotomy has in my hands been followed by sharp, secondary hemorrhages. In one instance this followed the removal of a wick that I had placed in a kidney beside a tube, a procedure that I have rarely used of late; in the other instance the bleeding was spontaneous and quite severe, coming some days after the removal of the tube. In both cases packing the wounds controlled it. The bleeding was not sufficient in either case to require transfusion.

There has been persistence of a loin fistula only in instances where I have employed nephrolithotomy as a primary operation in cases of calculous pyonephrosis, and in one instance when I removed a stone from a tuberculous kidney.

SUMMARY

In removing renal stones we have two pretty well standardized operative procedures, pyelolithotomy and nephrolithotomy. Briefly, pyelolithotomy is adapted to the removal of small stones in a uninfected kidney, while nephrolithotomy is best adapted to the larger stones and to instances where the kidney pelvis is dilated or infected. Our first object is the removal of the stone that jeopardizes the safety of the kidney with the least immediate risk to the patient and the least destruction of kidney tissue. However, in our anxiety for the immediate safety of the patient we must not overlook the fact that an inadequate operation will often subject the patient to the danger of a reformation of stone and another operation or if the stone is left, to the destruction of the kidney. We should in each instance make use of that procedure which we believe is best adapted to meeting the requirements of the case in hand.

THE OPERATIVE TREATMENT OF RENAL AND URETERAL CALCULI

WM. C. QUINBY

From the Urological Clinic of the Peter Bent Brigham Hospital, Boston, Massachusetts

The following remarks are based on the experience gained from the study of 250 cases of urinary lithiasis treated at the Peter Bent Brigham Hospital during the past six years.

Today it is generally acknowledged that not every stone in the kidney demands operative removal, for in many instances a calculus may be entirely quiescent, causing no symptoms or damage to the kidney. For this reason a conservative rather than a radical attitude is always to be advised. Furthermore, there is not sufficiently close similarity between cases of stone to permit the adoption of any routine form of operative treatment. Therefore each individual case must be judged on its own features after all possible evidence regarding it has been accumulated. Under what circumstances, then, do we advise operation for the removal of a renal or ureteral calculus? There are two main points to make operation advisable; first the size and position of the stone with reference to its interference with the flow of urine away from the kidney, and secondly the presence of infection. Other factors such as the functional condition of the kidney, the amount of pain and discomfort caused, and the integrity or not of the other kidney, although secondary considerations, are nevertheless also important. I therefore today advise against the removal of a renal stone which is causing practically no symptoms and is not in a position where blocking of the ureter seems imminent, and in which there is no accompanying infection. On the other hand, so also would I advise against the operative removal of an uncomplicated giant calculus for, in spite of the large size of the stone the function of the kidney

in such instances is frequently remarkably good. The rule that the larger the stone the fewer the symptoms has been well borne out in this series of cases. I also would advise against operative interference in instances where the shadow cast by the stone on the X-ray film is so small that there seems a very good chance of its being spontaneously passed. Such a size would roughly be anything up to about 5 to 6 mm. in diameter. Stones larger than this in our experience cannot pass without a very considerable degree of ureteral damage together with frequent and severe attacks of colic. It is my feeling that the mere presence of a calculus in the renal pelvis or calices without any other complicating factor is of little significance. With the advent of infection, however, the picture is immediately changed for the damage which then ensues to the kidney tissue is definite and rather rapidly progressive. Under such circumstances the stone should be removed. As stated above, however, decision for or against operation can only be made after a thorough study of both kidneys by ureteral catheter and by pyelogram on the affected side.

Having decided in favor of operation that form which is most ideal is removal of the calculus by opening the renal pelvis. No interference with the integrity of the kidney is caused, and the operation as a rule is very simple in its technique. Unfortunately, however, there not infrequently exist conditions which make a pyelotomy impossible, two common ones being a small intra-renal pelvis of a size inadequate for the necessary manipulations, and the second, a stone so situated that it cannot be reached even though the pelvis be widely opened. Under these circumstances it is our custom to perform a pyelo-nephrotomy; in other words to combine a localized opening through the cortex with a sufficient opening of the pelvis itself to permit counter pressure. The third type of operation is nephrectomy. This, necessarily, is a destructive operation, and I am certain should never be performed except in those instances where the kidney has no further functional value or when the degree of deformity and infection is very great. Decision for removal of the kidney in such instances is a matter of personal experience and judg-

ment. There is but little benefit to be expected from the removal of the calculus if the kidney be still unable to drain properly. If the other kidney be intact the diseased one had better be extirpated. On the other hand it is both surprising and gratifying to observe the very considerable repair of which the kidney is capable when it has once been relieved of stones and so adjusted that all portions of its interior drain readily into the ureter. I have never felt that a complete nephrotomy was either desirable or necessary, and myself have never been compelled to open the whole kidney in order to reach the stones. As we all know, the danger of secondary hemorrhage is very great, and the damage to the kidney substance caused by the sutures and other operative trauma is very extensive indeed.

When the stone is situated in the ureter the indications for its removal as a rule are much more definite, for although it be not entirely occluding the lumen of this tube, nevertheless it is surely giving rise to a very undesirable amount of increased intra-renal pressure. We advise removal of all ureteral calculi, therefore, except when they are of such size that spontaneous passage seems probable.

The approach to the ureter through an oblique abdominal incision of extra-peritoneal type gives access to all portions of this canal except its uppermost and lowermost ends. For those stones which have lodged but a short distance above the bladder, in women frequently at the broad ligament, a median extra-vesical approach is easiest.

When a calculus in the ureter is accompanied by extensive pathology in the kidney above, a nephrectomy, of course, is necessary. Under these circumstances is it necessary to remove the calculus in the ureter as well as the kidney itself? One is tempted to argue that the kidney being removed there no longer exists any reason for functional activity of the ureter, and this being so it is probable that the stone will remain quiescent, and become encysted. Such a line of argument was adopted in two instances in this series of cases, but found to be fallacious, for the remaining stone kept up an annoying cystitis in one instance, and in the other caused continuance of pain.

When there are stones in both kidneys the judgment as to which side should be operated on first is sometimes a rather difficult one. As a rule it is probably wiser to operate on the side showing the lesser renal function first, for by this procedure one has the better kidney to depend on during the first day or two following operation. It is then to be hoped that the kidney first operated on will have recovered a sufficient amount of function to make operation on the second one less dangerous. There can be, however, no general rule laid down, for especially in cases of bilateral calculus all possible factors must be taken into consideration. A recent case of this nature will serve for illustration.

A woman of thirty-six years, had suffered severely from renal calculi in both kidneys for about ten years. The stones in the right kidney could be easily felt on abdominal palpation, hard and occasionally crepitant. The kidney on this side showed very little function. The left kidney was of appreciably better function, although it also contained multiple separate stones, and on this side there had occurred the most recent symptoms. Furthermore in the left ureter, just above its entrance into the bladder, there was a calculus about 3 cm. in its longest diameter. It did not entirely obstruct the ureter, however, and a catheter could be passed by it. In this instance the immediate surgical indications seemed to be to remove the ureteral calculus as well as those in the kidney above, in spite of the fact that this was by far the better organ from a functional point of view. Operation was followed by a very considerable increase in renal function and convalescence was uneventful.

I must again emphasize the fact that conservatism is very important, especially in this group of cases where there are found stones not only in one but in both kidneys.

So far as the technique of operation on the kidney itself is concerned, I would like to emphasize one or two points. I think it is highly important to avoid extraction of a calculus through so small an opening that there is danger of leaving behind small fragments or spicules which may be broken off by the forceps. It has always been my endeavor to avoid, if possible the use of such instruments, except in the gentlest manner. For this reason I do not try to remove the calculus

from, let us say, an inferior calix by reaching it through a pyelotomy wound with forceps, but much prefer a localized incision through the renal cortex, the stone, meanwhile, being pushed upward toward the surface of the kidney by pressure from below or by pressure made by a finger inserted into the pelvis, or into the renal sinus. I much prefer to work with bare hands during this part of the operation, for the most acute sense of touch is very important.

The subject of missed stones or recurrent stones is an interesting and very important one. To meet this problem Barney has advocated an X-ray examination of patients before they are discharged from hospital. Many others have called on the radiographer for help, and have submitted the kidney to an examination by the fluoroscope on the operating table. This, however, makes desirable a method of darkening the room, or at least the wearing of dark goggles by the roentgenologist for some minutes before the examination is made. I have, therefore, thought it to be much easier to make an actual film of the kidney rather than to depend on the fluoroscope. This is very easy to do since the adoption of flexible X-ray films for, even in those instances where the kidney can not be well raised above the wound, the film itself can easily be tucked down along side the organ and a very satisfactory examination thus obtained. I have found this method of the greatest assistance; so much so that it is our present custom to have a film made in every instance before closure of the wound. To be sure from seven to ten minutes are necessary for the development of the film, but the personal satisfaction in actually seeing for oneself a plate of the kidney more than repays the wait. Therefore, although stones may, of course, form again, it is our confident expectation that by these methods none will be missed at the time of operation.

Just a word in regard to after care of patients who have been subjected to operation for removal of renal calculi. I am firmly convinced that every attempt should be made to render the kidney sterile by lavage in practically all instances. Numerous cases in our clinic illustrate the advantage of this procedure, for not only are the attending bladder symptoms ameliorated, but also the function of the kidney itself is frequently improved.

POSTOPERATIVE RESULTS OF NEPHROLITHIASIS[1]

WILLIAM F. BRAASCH AND GORDON S. FOULDS

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In 1917 a review (2) was made of 504 cases in which operation had been performed at the Mayo Clinic for renal lithiasis, and it was found that stone had recurred in approximately 10 per cent. The present study includes all such cases observed from January 1, 1898, to January 1, 1921, a total of 1041 cases and 1079 operations. Eight hundred and nineteen (78.67 per cent) of the 1041 patients were traced. All of the operations had been performed more than two years, thus affording a reasonable length of time for possible recurrence.

Our study was undertaken for the purpose of determining as nearly as possible the frequency of the recurrence of stone following operations for nephrolithiasis; the evident factors involved; the comparative results obtained with the various types of operations employed for the removal of renal stone, and incidentally to estimate how far conservative operation is justified, and to discuss the recent methods employed to assure complete removal of stone.

It is difficult to estimate accurately the incidence of postoperative recurrence of renal stone. It is obvious that unless a routine roentgenographic examination is made of the kidney at the time of operation, or soon after, it is quite impossible to determine whether a stone found subsequently was overlooked at operation or had recurred. Roentgenographic examinations after operation are not always infallible, however, since small fragments of stone, which may act as nuclei for the subsequent formation of stone, are occasionally overlooked. Further, in compiling statistics of recurrence, only those cases should be

[1] Read before the meeting of the American Association of Genito-Urinary Surgeons, Cleveland, May, 1923.

included in which conservative operations on the kidney have been performed, and it must also be determined whether the recurrence occurred in the kidney operated on.

TABLE 1

Subsequent clinical data on 819 patients operated on for renal lithiasis: 850 operations (31 bilateral)

	PATIENTS	PER CENT	RECURRENCE	
			Patients	Per cent
Type of operation:				
Pelviolithotomy	371	43.64		
Recurrence of stone in kidney operated on			44	11.85
Subsequent occurrence of stone in opposite kidney			7	1.88
Nephrectomy	327	38.47		
Subsequent occurrence of stone in opposite kidney			9	2.75
Nephrolithotomy	104	12.23		
Recurrence of stone in kidney operated on			25	24.03
Subsequent occurrence of stone in opposite kidney			0	0
Combined nephro-pelviolithotomy	48	5.64		
Recurrence of stone in kidney operated on			2	4.16
Subsequent occurrence of stone in opposite kidney			1	2.08
Operative findings at primary operation:				
Bilateral stones	77	9.05	9	11.68
Multiple stones	368	43.2	33	8.96
Single stones	467	54.94	55	11.77
Branched stones	85	10.00	11	12.94
Large stones	300	35.29	29	9.66
Small stones	519	61.05	70	13.48
Stones in the pelvis	644	75.76	75	11.64
Stones in the calyx	111	13.05	14	12.61
Stones in the cortex	135	15.88	14	10.37
Simple hydronephrosis	32	3.76	1	3.12
Cases in which stones were passed before Operation	137	16.11	22	16.05

The records of the 1041 patients revealed that there was clinical evidence of recurrence of stone in either kidney in 88 cases (10.79 per cent). If the 402 cases in which nephrectomy was

performed are deducted, there remain 677 cases in which conservative operations were performed, and among these there were 71, (10.48 per cent) in which there was clinical evidence of recurrence in the kidney operated on. The 88 cases of recurrence include (*a*) 23 in which the patients were re-examined with roentgen ray, cystoscopy, and so forth, following operation with positive results; (*b*) 36 cases in which there was a history of stones passing after operation, with symptoms referred to the kidney previously operated on; (*c*) 6 cases in which subsequent operations had been performed for stone elsewhere, or positive roentgenograms had been made elsewhere, and (*d*) 23 in which the subsequent history was indicative of recurrence in the kidney operated on. The accuracy of these data may be questioned on the ground that roentgenographic examinations were not made in all the cases included in the last group. However, a stone existing for many years without symptoms occurs only rarely. Furthermore, it is well known that many patients having pain referred to the renal area do not have lithiasis, so the number of these included would offset the number that may have been omitted because of lack of symptoms. In many cases included because of subjective symptoms in the estimate of recurrences in our previous review (2), it was found, on subsequent roentgen-ray examination, that stone did not exist. Therefore, it may be safe to assume that, if cases are included in which there are only symptoms indicative of renal stone, the actual incidence of recurrence will probably be increased.

Of 183 patients who returned to the Clinic at varying intervals following operation and who were subjected to careful examination, including roentgen-ray and cystoscopic, functional tests, and so forth, stone recurred in 26 (14.2 per cent). This percentage is practically identical with that observed among a similar group of patients reported in 1917 (2), which tends to corroborate its accuracy. However, it would be logical to assume that this group exaggerates the actual incidence of recurrence since it includes only patients having positive symptoms, and omits from consideration the large number who have not had symptoms for many years following operation.

The accuracy of the review of 677 patients who had conservative operations is supported by a similar study made separately of the 183 patients who returned for subsequent thorough examination. The comparative results and the percentage of recurrence with respect to the various factors involved paralleled almost exactly those obtained from the larger group.

Since January, 1915, all patients operated on for renal stone (685) have been rayed routinely at the time of dismissal, so that the possibility of stones being overlooked at operations has been largely excluded. These statistics do not include 31 cases in which shadows of stones were found in roentgenograms made immediately after operation. It is evident that these stones were either overlooked at the time of operation or they were so small that it was practically impossible to find them. It seems probable that fragments of stone so small that they could not be definitely identified either in the operative fluoroscopic examination or in the postoperative roentgenograms were occasionally overlooked and subsequently acted as a nucleus for stones in several of the cases included in the present list of recurrences.

In most cases, probably, the period of stone formation is limited. It evidently continues until the tissues become immune to the infecting organism, or an altered chemical balance is established. When the stone-forming period has passed, stones are not likely to recur following their complete removal from the kidney. In the 71 cases in which recurrence was noted, the average interval following the primary operation was approximately two years. The exceptions to the rule are the cases of so-called chronic stone-forming kidneys. In this type renal stones form repeatedly at comparatively frequent intervals; sometimes as many as 20 or 30 stones will be passed. That a considerable number of the 71 patients having recurrence of stone are probably included in the group having chronic stone-forming kidneys, is suggested by the fact that 22 (27.5 per cent) of these patients passed one or more stones prior to operation. After operation for recurrent stone, subsequent stone formation is not common; there were only 8 patients in our series who required three operations and these evidently had stone-forming kidneys.

FACTORS INFLUENCING RECURRENCE OF STONE FORMATION

In the search for possible etiologic factors involved in the formation of recurring stone, various clinical and operative data were reviewed, such as the number, size, form of the stones and their situation in the kidney, the type of operation, and so forth.

Number of stones. Contrary to expectation, recurrence was greater following the removal of single than multiple stones,

TABLE 2

Operations for recurrence of stone on 29 patients (2.78 per cent) who returned to the Mayo Clinic

	CASES
Recurrence of stone in kidney operated on	23
Subsequent occurrence of stone in opposite kidney	6
Average interval since primary operation, 23.32 months.	
Operative findings at primary operation:*	
Pelviolithotomy	14
Nephrolithotomy	11
Nephrectomy	5
Combined nephro-pelviolithotomy	1
Multiple stones	10
Single stones	21
Branched stones	3
Small stones	25
Large stones	7
Stones in calyx	5
Stones in pelvis	26
Stones in cortex	4

* Thirty-one operations (2 bilateral).

as shown by recurrence in 11.77 per cent of the former and 8.96 per cent of the latter. The average duration of symptoms in cases of multiple stones was considerably longer than in those of single stones, so that in many of this group the stone-forming period had passed.

Type of stones. There is a definite increase in incidence of recurrence following the removal of branched stones, 12.94 per cent in our series. This is probably owing to the fact that, in the removal of branched stones, small particles may easily be

broken off and overlooked at operation, or in the postoperative roentgen examination. If, however, the branched stone is cleanly removed and adequate drainage instituted, there should not be a greater percentage of recurrences. A considerable difference in the relative frequency of recurrence after the removal of large and small stones was found, the former being 9.66 per cent and the latter 13.48 per cent. If a large stone is completely removed, it is less likely to recur than a small one, evidently because in the majority of cases of stone-forming kidneys, the stones which form at repeated intervals are usually small and escape into the pelvis.

Situation of stone. The percentage of recurrence after removal of stones described at operation as being situated in the cortex is about equal to that of stones situated in the pelvis. Most of the stones in the cortex originated in the ends of the calices and were described as cortical, largely because it was necessary to remove them through the cortex.

Infection. Gross evidence of tissue infection did not seem to be a factor favoring recurrence. In fact, the percentage of recurrence was less than average when the areas of renal infection were thoroughly drained and all fragments cleanly removed.

TYPES OF OPERATION

Nephrectomy. Nephrectomy was found necessary in 402 (37 per cent) of the total number of cases. Marked diffuse infection or pyonephrosis was noted in 247 (61.44 per cent), and necessitated the comparatively large percentage of radical operations. The stones in the kidneys removed were commonly described as multiple, and were scattered in the calices or in areas of necrosis. Included in this series are 52 cases (12.93 per cent) in which the kidney had been operated on for stone elsewhere, and 3 at the Clinic.

In the presence of multiple, branched, or large stones, hydronephrosis or extensive areas of renal infection, the question frequently arises whether a conservative operation or a nephrectomy should be performed. The indications for nephrectomy

are: (*a*) when the kidney is functionless, or nearly so, (*b*) in the presence of secondary malignancy, (*c*) with diffuse advanced infection, (*d*) in the presence of marked hydronephrosis, and (*e*) when there has been a previous operation on the kidney with or without fistula.

The indications for a conservative operation are (*a*) in the presence of single or multiple stones easily removed without great damage to the kidney, (*b*) when multiple or large branched stones, marked infection, or some other serious complication is present in the other kidney, and (*c*) when there is a history of repeated stone formation in both kidneys.

The recent tendency in the surgical treatment of renal lithiasis is decidedly towards conservatism. The question has been asked, and with good reason: Why hesitate to remove the kidney containing stones when the opposite kidney is normal, since it is generally supposed that the patient with one healthy kidney lives just as long and is just as well as the patient with two kidneys. It would be difficult to answer the question accurately. A review of the postoperative results in cases in which nephrectomy was performed for lithiasis shows that the number of deaths from all cases subsequent to operation was 48 (14.67 per cent) in comparison with 10.7 per cent, in which a conservative operation was performed. In general, it may be said that conservative surgery is usually to be preferred if a good functional result can thus be obtained.

The patient's age should be taken into consideration in determining the type of operation advisable. In the case of a young person with a history of renal lithiasis of comparatively short duration, particularly a young married woman, the conservative operation should be employed. In case the patient is older and particularly if the clinical symptoms are of long duration, which would largely exclude the possibility of formation of stone in the other kidney, nephrectomy would merit more favorable consideration.

Technically, in the presence of multiple or branched stones, nephrectomy may be performed more easily than a conservative operation. However, the various complications which often

make nephrectomy necessary, also make it dangerous, as is shown by the fact that the highest operative mortality (1.69 per cent) occurred in this group, in comparison with 0.63 per cent following pelviolithotomy.

In case of doubt as to whether a conservative operation should be performed, it is important to consider the probable functional end-results rather than the possibility of recurrence. The destruction of renal function following the removal of multiple, large, or branched stones through an otherwise normal cortex, is often extensive. As we have previously noted (2), the advisability of any operation on a kidney containing stones of this type, in the presence of extensive bilateral lithiasis or other disease in the opposite kidney, is questionable, particularly in the absence of acute symptoms or complications.

In most instances in which nephrectomy had been performed, there was a history of symptoms of long duration, so that it might be inferred that the patient was safely over the stone-forming period. This is corroborated by the fact that stone occurred in the opposite kidney subsequent to nephrectomy in only 3 per cent of the cases. As Cabot has said, the probability of anatomic factors being present in the etiology of unilateral lithiasis is apparent.

Pelviolithotomy. In 469 operations, 43.46 per cent of the total number, and in 69.27 per cent of the conservative operations, pelviolithotomy was the operation of choice in the removal of stone from the kidney. This method was preferable so far as ease of technic and functional results were concerned, and was followed by a comparatively low percentage of recurrence (11.85 per cent). The recurrence can best be explained by the hypothesis that many patients in this group had chronic stone-forming kidneys; in such cases the stones usually form in the pelvis. It may be inferred that in most cases the patient was still in the stone-forming period at the time the stone was removed.

Nephrolithotomy. One hundred and fifty, 14 per cent of all the operations, and 22.15 per cent of the conservative operations, were nephrolithotomies. It is worthy of note that the per-

centage of recurrence following nephrolithotomy, 24.03 per cent, is comparatively high, and it may be assumed that cicatricial changes in the tissues at the site of the stone, and inadequate drainage, may favor re-formation of stone. If all fragments are removed, the method of approach should not materially affect the percentage of recurrence. It should be noted, however, that nephrolithotomy was performed on three-fourths of the patients with stone fragments in the kidney, which were missed at operation.

Nephro-pelviolithotomy. That a technical factor is involved is suggested by the fact that in the operations in which a combined nephro-pelviolithotomy was employed, there were comparatively few recurrences (4.16 per cent). The thorough drainage offered by this operation must be taken into consideration.

Contrary to the general impression, nephrolithotomy was followed by the lowest mortality, only 1 death in 150 cases. Serious postoperative hemorrhage was noted in only 8 patients; in four it was so severe that nephrectomy was necessary. In explanation of the comparatively few complications, it should be said that in most cases there was an area of chronic infection in the cortical tissue overlying the stone; moreover, in many cases the stone was covered by only a thin layer of cortical tissue. The possibility of postoperative hemorrhage in a normal cortex is undoubtedly greater than if there is necrotic and infected tissue in the cortex overlying the stone. Nephrolithotomy should be made as conservatively as possible; extensive incisions into the cortex are rarely necessary. As a rule, the stone is readily removed by inserting blunt forceps directly through the cortical tissue overlying the stone. In most instances this tissue is more or less diseased. Experience has, therefore, demonstrated that if the stone is situated at the end of a calyx and is not readily accessible through the pelvis, nephrolithotomy is the method of choice, and for even more complete removal and thorough drainage, the combined nephrolithotomy and pelviolithotomy method is preferable. The efficiency and safety of the combined operation is shown by the fact that there was but 1 death in 58 cases, and that there was a recurrence of stone in only 3 of these, a little more than 5 per cent.

However, in most cases the reduction in renal function following extensive nephrolithotomy in the presence of a comparatively normal renal cortex, is greater than that following pelviolithotomy. Extensive nephrolithotomy in an otherwise normal kidney is occasionally followed by secondary infection, persisting renal fistula and complete destruction of renal function. Conservative operations in cases of large coral shaped stones, necessitating extensive nephrolithotomy in their removal, particularly if the stones are bilateral and without renal infection, are, as a rule, not advisable. On the other hand, in the presence of areas of cortical necrosis and infection, nephrolithotomy, even if extensive, is often followed by remarkable improvement in renal function.

Renal fluoroscopy. From recent literature and the reports of various surgeons, it is evident that a large percentage of operations for the removal of renal lithiasis are unsuccessful. In 1915 Cabot and Crabtree reviewed the postoperative course of patients operated on for renal stone at the Massachusetts General Hospital, and found recurrence in 43 per cent. Barney, in reviewing a later series operated on at the same hospital, reported recurrence in 32 per cent. However, on subjecting 20 of these patients to postoperative roentgen-ray examination, he found that stones were still present in nine (45 per cent). What was originally regarded as postoperative recurrence, in the light of subsequent study, is apparently largely a matter of overlooked stones as suggested by W. J. Mayo. As a means of preventing the incomplete removal of stone at operation, which seriously impairs the value of nephrolithotomy, renal fluoroscopy is exceedingly efficient. We have now used this method in 219 conservative operations, and have found it to be of such great practical value that we question whether a conservative operation for renal lithiasis is justified without its use. From September, 1919, when we first successfully tried this method, until January 1, 1921, we employed it in 81 operations; in only 4 (4.93 per cent) have stones recurred.

The reasons advanced in our original article (2) for the desirability of employing operative renal fluoroscopy have, in the light

of subsequent experience, proved valid. Some of the numerous advantages are as follows:

1. Small, and even large stones may not be found at operation, as evidenced by the fact that in 28 of our cases, 5.01 per cent of the total number in which operation was performed elsewhere without finding stone, we subsequently removed the stone by the aid of the fluoroscope.

2. Doubtful shadows may be identified, and whether they are extrarenal or intrarenal may be determined.

3. The stone may be exactly located for the benefit of the operator.

4. The possibility of fragments remaining from large or irregular stones may be determined.

5. The presence of multiple stones may be detected in order to insure their complete removal.

The difficulties in interpreting shadows in the roentgenogram are familiar to all. To illustrate how inexact the interpretation may be: (*a*) a single shadow was reported in the roentgenogram and multiple stones were found at operation in 146 cases; (*b*) multiple shadows were reported in the roentgenogram, and a single stone found at operation in 66 cases; (*c*) the absence of shadows was reported in the roentgenogram, and one or more stones were found at operation in 21 cases, and (*d*) shadows were reported to be in the upper ureter, but at operation stones were found in the kidney, not in the ureter, in 5 cases.

Fluoroscopy has been of inestimable value in determining the exact position of fragments remaining in the kidney, so that unnecessary destruction of renal tissue is obviated. Fluoroscopy of a kidney which cannot be completely delivered because of a short pedicle, or as the result of being fixed by adhesions, or because of anomaly, and so forth, is occasionally unsatisfactory; nevertheless, in cases in which the kidney was only partially delivered and the patient was not too large, accurate renal fluoroscopy was usually feasible. It has been asserted that small stone fragments can easily be overlooked by the fluoroscope. However, the only roentgenographic evidences of such a possibility are the minute shadows which are

sometimes observed in a roentgenogram postoperatively in cases in which the fluoroscope has shown the kidney to be negative. It is frequently impossible to determine whether these shadows are intrarenal without subsequent observation. Furthermore, with accuracy of technic, the percentage of such error is low.

The personal equation of the fluoroscopist is also a factor in the success of the technic, the more skilled and experienced the operator, naturally, the more accurate the results. Precautions in preparation, such as preliminary darkening of the eyes, darkening of the room, and so forth, must be rigidly adhered to. Care should be taken to remove all foreign objects from the line of vision. The kidney should be lifted as high as possible; this may best be accomplished by suspension with a thin piece of gauze. It should be moved in different angles while under fluoroscopic inspection. The stone can be exactly localized with the aid of the operator's finger in the pelvis, or a pointed instrument in the hands of the fluoroscopist. The method places the responsibility of finding the fragments squarely on the operator, and often it is no easy task to discover minute stones. That the method is not perfected as yet is evident from the occasional failures; nevertheless, it is a vast improvement over former incomplete methods of nephrolithotomy, and the operation is hardly complete without it.

CONCLUSIONS

1. The percentage of actual recurrence in the kidney following conservative operation is less than 10 per cent.

2. Many of the so-called recurrences are really stones not discovered at the first operation.

3. There is a definite period of stone formation, and the high percentage of recurrences may indicate that the patients were not completely past this period at the time of operation.

4. The percentage of subsequent recurrence in the remaining kidney following nephrectomy is so low (2.75 per cent) as to indicate that an anatomic factor was present in the affected kidney.

5. The percentage of recurrence is greater in cases of single than of multiple stones, and of small than large stones.

6. The percentage of recurrence does not vary greatly with the type of operation for the removal of stone, but rather with the thoroughness.

7. While pelviolithotomy is the method of choice when possible, the dangers of limited nephrolithotomy have been exaggerated, the percentage of patients having nephrolithotomy who had subsequent hemorrhage being small.

8. Nephrolithotomy is particularly indicated in the presence of cortical degeneration adjacent to the stone.

9. There is a definite group of cases with a history of repeated formation of stone occurring at frequent intervals over a long period.

10. The average interval between primary operation and recurrence of stone is approximately two years.

11. Fluoroscopy has proved to be of great practical value, and no conservative operation for renal lithiasis is complete without it. The percentage of recurrence following operation if the fluoroscope is used was found to be under 5 per cent.

REFERENCES

(1) Barney, J. D.: Recurrent renal calculi. Boston Med. and Surg. Jour., 1922, clxxxvi, 9–14.

(2) Braasch, W. F.: Clinical data of nephrolithiasis. Surg., Gynec. and Obst., 1917, xxiv, 8–14.

(3) Braasch, W. F., and Carman, R. D.: Renal fluoroscopy at the operating table. Jour. Amer. Med. Assoc., 1919, lxxiii, 1751–1752.

(4) Cabot, H. and Crabtree, E. G.: Frequency of recurrence of stone in the kidney afer operation. Surg., Gynec. and Obst., 1915, xxi, 223–225.

(5) Mayo, W. J.: The removal of stones from the kidney. Surg., Gynec. and Obst., 1917, xxiv, 1–8.

CYSTIN NEPHROLITHIASIS

REPORT OF A CASE WITH RADIOGRAPHIC DEMONSTRATION OF DISINTEGRATION OF STONE BY ALKALINIZATION

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Cystin nephrolithiasis is a rare but a very interesting condition. It is especially interesting; first, because of the uncertainty of its etiology, second, because of the probable infrequent recognition of the disease, and third, because of the excellent results which may be obtained by proper diet and internal medication. The disease has been known for more than one hundred years. It was first thought to be due to anomalous metabolism similar to that occurring in gout and diabetes. Link was able, in 1912, to collect from the literature only 146 cases. To our knowledge, we have had only 1 case at our Clinic. We probably have had others but did not recognize the condition.

A great many theories have been presented and considerable laboratory work done in connection with clinical observations in order to arrive at a satisfactory explanation of cystinuria but thus far we are far from it.

One of the earliest beliefs was that there was an abnormal catabolism of protein in the intestinal tract with a consequent production of cystin so much in excess that it could not be disposed of and was excreted unchanged in the urine.

Blum disposed of this theory by his experimental proof that large amounts of cystin when given by the mouth even to the limit of toxicity could be oxidized in the body without the production of cystinuria.

Thiele found that the amount of cystin execreted was practically independent of the diet. The patient was able to break up cystin administered by the mouth, even though it was cystin previously excreted by him.

The modern view of the production of cystin in the body is that it is due to some error in metabolism. This error involves some of the end decomposition products of protein of which cystin

FIG. 1

is the most important. The oxidization of some of the other amino-acids and the diamines may also be inhibited. There is a varying extent of error as regards the number of protein fractions involved.

Alsburg and Folin, as a result of their study of the subject, believe that the cystin excreted is proportionate to the protein intake. Reduction of protein intake reduces the amount of cystin in the urine but does not get rid of it altogether. Their observations lead them to believe that alkalies do not act as a solvent but influences metabolism so that cystin is not formed and excreted as such.

FIG. 2

Standhagen and Brieger believe it an infection. The frequent coincidence of cystinuria and constipation would favor this theory. Wasserthal pointed out that the frequent coincidence of articular rheumatism and cystinuria was significant for this theory.

Moreigne concluded that cystinuria is a condition of nutrition, caused by partial arrest of oxidation. He says the infectious theory is not compatible with the fact that cystinuria lasts for a life time.

Ackerman and Kutscher state that it is generally accepted now that the cause of cystinuria is a suppression of amino-acid catabolism.

FIG. 3

Wolfe and Shaffer say that cystin in high protein feeding is largely of exogenous origin, but a part is probably not derived from food protein. To what extent strictly endogenous processes play a part in its formation is impossible to say.

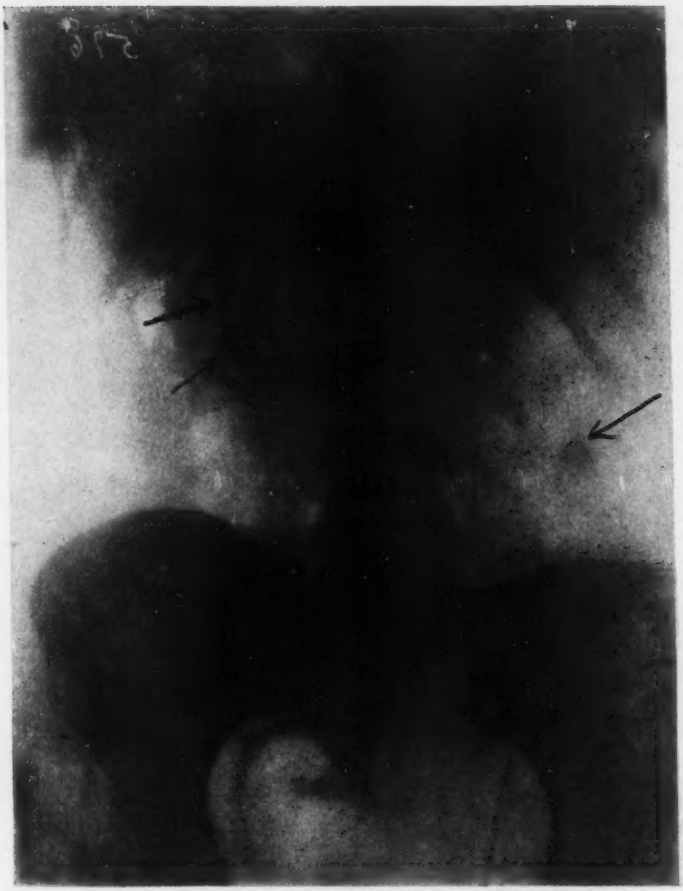

FIG. 4

DIAGNOSIS

The presence of a stone in the bladder or a shadow in the kidney, associated with cystin crystals in the urine or its presence in solution in the urine, suggest the diagnosis of cystin nephrolithiasis. Absence of cystin from the urine chemically or micro-

scopically does not mean that the stones are not cystin. It occasionally disappears from the urine temporarily. Many observers believe it will return regardless of treatment. Some think it is impossible to entirely free the urine from it. Alsburg and Folin hold to this theory. Bloody urine associated with pain

FIG. 5

in the back may mean cystinuria even though there be no shadow in the kidney region. The question can be cleared up by urinalysis. Many cases of kidney colic and back pains may be produced by the passage of cystin crystals.

PROGNOSIS

The prognosis of cystin nephrolithiasis is considered good as to life but not good with respect to cure. Recurrence of cystin stone

FIG. 6

following nephrolithotomy has been considered almost certain but our experience with the condition leads us to believe that we may not only prevent recurrence but also bring about disintegration by proper management and treatment. When these stones do form, the usual sequelae of stone-formation follow,

the resulting pathology being dependent upon the location and size of the stones.

FIG. 7

Before taking up the treatment of this condition, I wish to report the following case which came under our care January 1, 1922.

Case 6417. Female, aged twenty-seven, single.

Family history. Parents living and in good health. Paternal grandfather had kidney colic when a young man but lived to be over eighty years of age. One paternal aunt died of "kidney trouble." One sister thirty-seven years of age had a right nephrectomy performed

FIG. 8

four years ago on account of a large stone and infected kidney. She now has two stones in the left kidney. With these exceptions the family history is negative and the members were generally long-lived.

Past history. Patient has suffered more or less all her life with some frequency of urination and pain in the back. She passed what she termed a "shower of stones"—20 to 25—in 1913 but never suffered with colic until two days previous to coming under our care. A large stone

was removed from the right kidney by Dr. Shipley of Baltimore, June, 1921. At this time the radiographs showed 2 small and 1 large stone in the left kidney. These were removed by pyelotomy November 2, 1921. At the time of this second operation the radiographic examination revealed a recurrence of stone in the right kidney pelvis. Dr. Shipley writes me that these stones were analyzed in the University Laboratory and found to be composed of cystin. Chemical analysis of the urine also showed the presence of cystin.

Present illness. The patient came to our clinic January 1, 1922. She had been suffering with nephritic colic for two days and was brought in on a stretcher. Her temperature was 103°F., pulse 130, tongue dry, and the patient was very toxic. In fact, she was in a semi-comatous condition and in every respect appeared to be a very sick woman. Cystoscopy showed the left ureteral opening normal in appearance and functioning regularly. A large stone was seen in the right ureterovesicle opening. An effort was made to dislodge it with the beak of the cystoscope. Failing in this, a No. 9 ureteral catheter was finally passed by the stone and an abundance of pus obtained. The catheter was fastened in and retained for thirty-six hours, during which time the pelvis was lavaged every three hours with saline solution. The temperature rapidly dropped, the extremely parched tongue became moist, the delirium disappeared and the patient was much more comfortable in a very short time. As a result of ureteral dilatation the large stone observed in the ureteral opening was voided within twelve hours after the retention catheter was removed. This was analyzed and found to consist entirely of cystin.

Five days later the phthalein, after intravenous injection, appeared in the urine from the right kidney in three and one-half minutes and the output in fifteen minutes was 5.25 per cent with a concentration of 0.19 per cent to each milliliter. The phthalein appeared in three minutes from the left and the output in fifteen minutes was 5.5 or 0.38 per cent to each milliliter of urine, thus showing the function better on the left side. This, in connection with a few granular tube casts and a trace of albumen, would indicate a pyelonephritis. Radiogram showed a large stone in the right kidney and 3 smaller ones in the left. Leucocyte count was 12,050. Wassermann reaction was negative. Pelvic lavage with mercurochrome and saline solution was given every second and third day for about forty-five days. During this time her urine was kept alkaline by taking sodium bicarbonate. The infection gradually disappeared and the kidney function improved. She went home with

instructions to keep her urine alkaline by taking bicarbonate of soda and report weekly for pelvic lavage. The stones shortly began to reduce in size and continued until they disappeared entirely from the kidneys nine months thereafter. In addition to the disintegration of the stones the infection cleared up and the urine is free from cystin. The patient is now 35 pounds heavier then when she first came under our care.

In our case the kidneys have been freed from stones and the urine from cystin by keeping the urine alkaline. This had been accomplished without rigid limitation of protein in the diet. She is still taking soda and has not been under observation sufficiently long to know the ultimate results.

TREATMENT

Since cystin is soluble in alkaline solutions, a very important part of the treatment is to render the urine alkaline and keep it so. The lower the protein intake, the easier this will be accomplished. Sodium bicarbonate is about the best for this purpose.

Pelvic lavage with an alkaline antiseptic solution should be used and certainly if we have pelvic infection. This can be done every day but every second or third day is better. The solution should be warm and an amount just below the pelvic capacity used and retained five to fifteen minutes—this depending upon the amount of reaction produced by the drug. This lavage should be followed by one with saline solution. We used in our case mercurochrome and saline solutions every second or third day. Mercurochrome is alkaline as well as antiseptic. It is also very penetrating. We believe the lavage with these alkaline solutions assisted in the disintegration of the stones in our case and hope the plan may be tested further. Of course, the whole problem is unsolved and will be until its etiology is more definitely settled.

Surgery has usually been considered the proper treatment. This has been very unsatisfactory on account of the great frequency with which the stones recur. In so far as I have been able to ascertain, recurrence has been the rule. Nearly all agree that the diet should have a low protein content. Every precaution should be taken to prevent infection. All instrumenta-

tion should be avoided when there is no infection until a careful microscopical and chemical analysis has been made of the urine to see if there be cystin crystals in it or cystin in solution. Certainly no ureter catheterization should be done if a non-operative plan of treatment is to be pursued unless it be with the view of assisting stone disintegration by the use of alkalies in pelvic lavage.

CONCLUSIONS

1. The etiology of the disease is still unsolved but it is probably due to faulty metabolism.
2. The urine should be examined for cystin in all cases of kidney colic and back pains whether or not they are accompanied with kidney X-ray shadows.
3. If the stone is associated with cystinuria, disintegration should be attempted by the internal administration of alkalies, pelvic lavage with alkaline solutions, and limitation of protein diet.

I am greatly indebted to my associated, Drs. Thompson, Todd, McKay, and Squires for valuable suggestions and assistance in the management of this case as well as to Dr. E. A. Livingston who referred the case to us. It was at the suggestion of our clinical pathologist, Dr. Todd, that the plan of treatment with alkalies be tried with a view to rendering the urine alkaline and therefore a solvent of cystin.

REFERENCES

ABERDALDEN: Weiterer Beitrag zur Kenntnis des in Harn und in Harsteinen vorkommenden Cystins. Ztschr. f. Physiol. chem. Strassf., 1919, civ, 129–132.

AREBA, F.: Su di caso di cistinuria in seguito a ferta perforante del rene. Origine renale della cistina? Monde med Roma, 1920, ii, 39–46. (Not abstracted.)

BEER, E. Cystin Nephrolithiasis; Colon Bacillemia. Internat. J. Surg., N. Y., 1920, xxxiii, 219–221.

FRANKENTHAL: Uber Cystinuria und Cystinsteine. Deutsche Ztschr. f. Chir., Leipz., 1914, cxxxi, 442–465.

JACOBY, M.: Zur nephrolithiasis bei Zyxtinurie. Bel. klin. Wchnschr., 1920, lvii, 446–448.

KRETSCHMER, H. L.: Cystinuria and Cystin stones. With a report of a new family of cystinurics. Urol. and Cutan. Rev., St. Louis, 1916, xx, 1–10.

LICHTENSTERN: Ein Fall von Cystinurie und Konkrementbildung in der rechten Niere. Wien. klin. Wchnschr., 1903, xvi, 544.

LINK, RUDOLF: Beitrag zur Kenntnis der Cystinnurie und der Cystinsteine. Dissertation. Leipzig, Sturm and Koppe (A. Dennhardt), 1912.

MACALPINE, J. B.: Specimen of cystin calculi from the kidney of a child. Proc. Roy. Soc. Med., London, 1921–1922, xv, Sec. Urol., 36.

MILLER ACHILLES: Uber Cystinurie und Cystinsteine. Wien. med. Wchnschr., 1911, lxi, 2364–2370.

ROSENSTEIN, PAUL: Nierensteinoperation bei einer Einnierigen. Berl. klin. Wchnschr., 1906, xliii, 1606.

ROSENFELD, G.: Ueber Cystnurie. Bel. klin. Wchnschr., 1917, liv, 957.

BÖDTKER, EYVIND: Beitrag zur Kenntnis der Cystinurie. Ztschr. f. phys. Chemie, Leipz. and Berl., 1905, xlv, 393.

KLEMPERER, G., AND JACOBY, M.: Zur Behandlung der Cystinurie. Die Therapie der Gegenwart, Berlin, 1914, 101.

LOEWY, A., AND NEUBERG, C.: Uber Cystinurie. Ztschr. f. phys. Chemie, Leipz. and Berl., 1904–1905, xliii, 338.

MOREIGNE, HENRI: Étude sur la cystinurie. Arch. de méd. expér. et d'anat. pathol., 1899, ii, 254.

MÖRNER, K. A. H.: Cystin, ein Spaltungsprodukt der Hornsubstany. Ztschr. f. Phys. Chemie, Leipz and Berl., 1899, xxviii, 595.

MÖRNER, K. A. H.: Zur Kenntniss der Bindung des Schwefels in den Proteinstoffen. Ztchr. f. phys. Chemie, Leipz. and Berl., 1901, xxxiv, 207.

MORRIS, HENRY: On the X-ray shadows of cystic and xanthic oxide calculi. Lancet, Lond., 1900, cxix, 39–54.

SIMON, CHARLES E.: Cystinuria and its relation diaminuria. Amer. Jour. Med. Sci., Phila., 1900, cxix, 39–54.

SIMON, CHARLES E., AND CAMPBELL, D. G.: Uber Futterungsversuche mit Cholasäure bei Cystinurie. Beitr. z. chem. Phys. u. Path., Brnschwg., 1904, v, 401.

SIMON, CHARLES E.: Uber Futterungsversuche mit Monoaminosäuren bei Cystinurie. Ztschr. f. phys. Chemie, Leipz. and Berl., 1905, xlv, 357.

STADTHAGEN, M., AND BRIEGER, L.: II Ueber Cystinurie, nebst Bemerkungen über einen Fall von Morbus maculous Werlhofii. Berl. klin. Wchnschr. 1889, xxvl, 344.

UDRANSZKY, L. V., AND BAUMANN, E.: Ueber das Vorkommen von Diaminen, sogenannton Ptomainen, bei Cystinurie. Ztschr. f. phys. Chemie. Leipz. and Berl., 1889, xiii, 562.

INTRA-URETERAL MANIPULATION OF URETERAL CALCULI

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In reviewing a series of 429 ureteral calculi passed or removed from 317 patients during a period of 17 years of which number but 47 have required open operation, I am decidedly impressed with the advisability of treating the vast majority of these cases conservatively.

Many calculi are passed by patients after a single attack of renal colic. There are also many individuals who after an attack of colic seek no medical advice, who do not undergo a urological or even X-ray examination and harbor a calculus for years, during which time they may present more or less vague symptoms which are not directly associated with the urinary tract, and with a later colic or an abdominal X-ray the presence of the calculus is discovered.

Small calculi are often found in the lower ureter, in the intravesical portion or more often between 3 and 10 cm. from the ureteral orifice. A small soft X-ray ureteral catheter or bougie will often pass such a calculus but carefully taken roentgenograms with such a guide in position should reveal their presence in nearly every case. A wax-tipped catheter will be of value in doubtful cases.

If the catheter is obstructed by such a small calculus, the calculus should be demonstrated in a roentgenogram. Following the intra-ureteral manipulation of small calculi with ureteral catheters and bougies, the patient often has a colic and a second roentgenogram with or without a catheter in position may or may not show the shadow of the calculus. This does not always mean that the calculus has been passed by the patient, for small uric acid calculi are easily missed in imperfect X-ray

films, when a previous more perfect film has shown its presence. Patients have returned a month or two after such manipulation, bringing the calculus which they have passed when apparently negative roentgenograms had given false assurance of its being previously passed. Such small calculi often present spiculae which catch in the ureteral mucous membrane or the stone becomes impacted in a transverse position.

The simple shifting of the axis of a small calculus by means of manipulations with a ureteral bougie or catheter or the retention for twenty-four hours of a ureteral catheter which has slipped by the stone aided by the propulsive force of the urine and the enlarging of the ureteral orifice with a cut at its superior margin with a fulguration wire is sufficient to insure its passage in nearly all cases. Such intra-ureteral manipulations may be carried out without pain other than possible subsequent colics and should be repeated at intervals, preferably not oftener than once a week. Seldom does a patient fail to coöperate when assured that such treatment probably means avoidance of open operation. Every calculus removed at operation has had one measurement of at least 8 mm. and most of them have been much larger, have been rounded at the ends (which calculi engage poorly in the intra-vesical portion of the ureter) and have remained stationary in one position in the ureter often for weeks or months.

While the greater number of large ureteral calculi are found lodged at the junction of ureter and kidney pelvis; in the upper ureter; or at the pelvic brim; yet many are found impacted at the point where the ureter enters the bladder, or in the bladder wall.

Nineteen calculi of appreciable size first located in the kidney or in the upper ureter have been traced through the entire ureter until passed. In each instance little hope was entertained of avoiding operation, but following each manipulation there was a colic and roentgenograms demonstrated the descent of the calculus in the ureter.

On the other hand calculi impacted at the pelvic brim have been pushed upward by manipulation and were in a difficult

position for removal at operation, as in two recent cases in which at operation the calculi were lodged midway between kidney and pelvic brim, when twenty-four hours previously in roentgenograms they were demonstrated at the brim of the pelvis.

One patient with a single kidney entering the hospital with complete anuria passed an impacted ureteral calculus following one manipulation. A second patient in uraemic coma with a large calculus impacted in each lower ureter, an extremely poor operative risk, was relieved at once of kidney retention on one side by enlarging one ureteral orifice by means of fulguration. Subsequently, following intra-ureteral manipulation, both calculi were passed. Later 5 calculi from one kidney and 2 from its fellow, were passed, these calculi being recurrences, each kidney having been previously operated upon for calculi.

Another patient presented two large calculi each over 2 cm. in length and 1 to 1.5 cm. in breadth, impacted in the left lower ureter. He was a large man, a poor operative risk due to cardiac and renal complications. A large left direct inguinal hernia had several times been repaired, the last time with imbedded silver wire which would have been removed if open operation had been necessary. Although a seemingly hopeless procedure, following two intra-ureteral manipulations consisting of wedging a ureteral catheter in between the calculi and ureteral wall and applying traction, supplemented by enlarging the ureteral orifice with the high frequency spark, both calculi dropped into the bladder with the separation of the small slough of mucous membrane, and were removed by litholapaxy.

A woman of twenty-eight with a calculus 1.5 by 1 cm. in size which had been lodged in the left ureter for three years, at a point 2 cm. from the bladder, with an infected hydronephrosis above, passed her calculus after one intra-ureteral manipulation and an enlargement of the ureteral orifice; the infection in the kidney rapidly disappeared and she has been well since.

A woman first seen eighteen months ago with a calculus 1 by 1.5 cm. in size impacted in the left ureter 3 cm. from the bladder and an infected kidney above, disappeared from observation to return one month ago. At this time the calculus

was lodged 1 cm. from the ureteral orifice and was passed twenty-four hours after cutting the ureteral margin with the high frequency.

In 9 instances a soft calculus has been broken up or a collection of gravel dislodged and passed following a single manipulation.

The largest calculus passed by a patient after intra-ureteral manipulation was 4.25 by 1.5 cm. in size. Twelve calculi were subsequently passed from the same side, each after manipulation; and a kidney which seemed permanently impaired beyond repair was freed of infection through ureteral catheter drainage, pelvic lavage and support of the kidney.

During the past month I have removed three ureteral calculi by open operation: one was 3.25 cm. long, 1 cm. in diameter and tightly wedged between two strictures in the left lower ureter. Manipulation of a calculus impacted in this manner is obviously futile and shows poor judgment. Larger calculi have passed but as the manipulation incident to the first examination showed that the calculus could not be moved, operation was indicated at once. Although this calculus had probably been lodged in this position for two years there was no infection of the kidney above or damage to kidney function.

A second case presented a calculus impacted in either ureter at the pelvic brim and a small calculus in the left kidney. The calculus was removed from the left ureter. The calculus has passed from the right ureter following intra-ureteral manipulation and the calculus in the left kidney has descended into the lower ureter and will probably pass after enlarging the orifice.

In a third patient with a history of three colics, a calculus 1.5 by 1 cm. in size lodged just above the right pelvic brim, which, after manipulation, did not change its position in three weeks' time, was removed.

A patient now under observation presented a calculus of about the same size as the preceding lodged at the left ureteropelvic junction, was prepared for operation, but within forty-eight hours after the first manipulation the calculus descended 12 cm. and further manipulation will be carried out before again deciding upon operation.

In another recent case 2 large calculi lodged in the lower left ureter pushed the bladder mucous membrane ahead of them giving a cystoscopic picture of an infiltrating bladder tumor. A roentgenogram showed the calculi. Fulguration was attempted but as the patient preferred open operation to waiting, I opened the bladder; cut the mucous membrane over the calculi; and allowed them to fall into the bladder. The same result would have been obtained in a few more days with the separation of the slough resulting from the fulguration.

There are so many phases to the question as to when to operate and when to carry out intra-ureteral manipulation and how long the latter is justifiable that I believe one can only use his own judgment in each individual case. Such judgment must be based upon one's experience in this work, the conditions present in the individual case as regards local pathology, the patient's general physical condition and temperament.

Obviously there are calculi of such size and shape, especially when lodged above the intra-vesical portion of the ureter, where manipulation is unjustifiable, the possibility of their being passed being practically nil. A calculus impacted in a ureter with a hydronephrosis above, should be removed if it cannot be dislodged at once. An impacted calculus with an infected kidney above and symptoms of septic absorption, must be removed if it cannot be dislodged at once. Complete anuria may follow manipulation in bilateral calculi and such a possibility must be borne in mind in these cases. In bilateral impaction, the removal of one calculus should be carried out at once if it is not passed after a single manipulation. More time may be given to the manipulation of the calculus on the opposite side if it is one that shows prospect of such a delivery. If a calculus is lodged above a constriction in the ureter which constriction cannot be eliminated such as stricture, kink, distortion from pressure or anomaly, the calculus should be removed by operation.

That these conditions are rare is shown by the large percentage of calculi passed through the ureter—as compared with those requiring open operation. Unless intra-ureteral manipu-

lations are skillfully carried out, under strict asepsis, without traumatism, and shock to the patient; and patience is used in waiting a sufficient length of time between manipulations, the patient meantime being under close observation, and a high degree of general physical tone maintained, open operations are certainly indicated more often.

While all of the modern intra-ureteral instruments for the purpose of dilating, cutting the ureter, or grasping the calculus have been used and are still occasionally employed, we have had better results, as regards the ultimate passing of the stone, less pain and traumatism incident to manipulation, and an absence of infections, following the simple shifting of the axis of the calculus or traction on the calculus by the use of soft ureteral bougies or catheters wedged in between the calculus and ureteral wall or coiled about the calculus, supplementing such manipulations by enlarging the ureteral orifice by means of fulguration. The work is painstaking and often tedious, but justifiable as shown by results. There has been no mortality in these cases, nor has subsequent nephrectomy been necessary.

As before stated each case must be studied and treated individually, not according to fixed rules or classes. Every precaution should be taken to prevent kidney infection, which is predisposed to in the presence of partial or intermittent ureteral obstruction. The work must be constantly checked off with good roentgenograms and one should never hesitate to change his course at once and resort to open operation when kidney damage becomes a possibility, or recurrent colics are too exhausting to the patient.

Colics should be relieved as much as possible by the application of heat, by hot baths and colonic irrigations, opiates being used as little as possible.

Subsequent periodical observation of patients who have harbored calculi is important. To prevent a recurrence, all factors entering into their formation such as focal infections, poor gastrointestinal function and pathology in the urinary tract should be eliminated, if possible.

DISCUSSION

Dr. GEORGE GILBERT SMITH (Boston): I would like to present a slide showing the size of calculus that will pass the ureter. This man, aged thirty, came last November and X-ray examination showed calculus of the kidney. The cystoscope showed no calculus in the bladder, but we found this in the kidney. The pyelogram showed a normal kidney pelvis and normal sized ureter. We assured the patient he could not pass it, but he went away and we did not see him until a couple of weeks ago. He said he had had some pain for which he had taken morphine. The X-ray showed this shadow in the bladder, and the cystoscope showed an oval white stone lying in the base of the bladder. We could not tell how large it was because we crushed it. I think it is interesting as showing how large a calculus can pass through the ureter without there being any evidence of ureteral dilatation.

Dr. WILLIAM WARREN TOWNSEND (Burlington, Vermont): I would like to ask Dr. Quinby his technique in using those film holders?

Dr. JOHN R. CAULK (St Louis): No subject in urology is more interesting than the stone problem. Dr. Braasch has told us about the "stone age," or the calculus climacteric. I do not know when that age is, but I would like to find out.

Aside from curing the patient of stone, we must prevent reformation, and this has been dwelt upon by the different essayists. I think we all agree, and have agreed on accuracy in diagnosis—thoroughly localizing the stones and understanding the problems that go with the stones—infection, retention, etc. I do not believe we have paid enough attention to the preliminary preparation of these patients—drainage, washing out the pelvis and getting them as clean as possible before we do any surgery. Every man has his own surgical technique, but both Drs. Braasch and

Quinby laid stress upon a combined pyelo-nephrotomy. In our series of cases reported at Boston two years ago, we had done 35 per cent combined pyelo-nephrotomies, principally for thorough cleaning of the pelvis in order to wash out all the small fragments of stone and sand. Then we have been putting in antiseptics to hasten healing and prevent a point of precipitation. I believe in the case of multiple or soft stones a combined pyelo-nephrotomy is of great value. I, furthermore, believe that all cases of soft stones or stones with infection should be followed after operation with ureteral catheterization and pelvic instillation.

I am glad to hear Dr. Quinby speak of the X-ray in the kidney. In 1897 Fenwick proposed to take plates of the kidney at operation, and here we have waited twenty odd years for its rejuvenation.

I am in accord that many of the recurrences are fragments which are left behind, and it is surprising how large fragments can be left behind. Six months ago we had a patient whose picture showed an enormous stone, and when we got in we found there were 8, or 10 stones. I did a nephrotomy, and with complete and thorough palpation between the fingers we could not find another stone; but in about two weeks the patient was back again, and we found another stone which had come down from the upper calyx.

Dr. Francis R. Hagner (Washington, D. C.): I think we are fortunate to have such a program as we have had this morning. I wish to speak of but two points. The first is cystin nephrolithiasis. I am sure this is a rare condition. I had 1 case, but I did not realize it before I operated. I did not have the good results that Dr. Crowell did, because my patient died. But we learned a good lesson from this. He turned out to be a hemophiliac. I had operated his father and removed an enormous stone and pyonephrotic kidney. He recovered, and later brought his son, a boy of twenty-one. I operated him, the operation taking only about twenty minutes because the stones were easily located. When they were removed they were

peculiar looking, just about like those the Doctor showed, but the edges were much rougher in character. This boy bled for a couple of days, and then following that we began to ask questions and found that his mother was a hemophiliac. He bled for a month, and finally died. Since then we have had routine coagulation tests. His coagulation test was nearly nine minutes.

I think Dr. Bugbee has brought forward a fine thing in the relief of ureteral calculus by manipulation. I do not believe that I have operated on more than 3 cases in the last two years. We have succeeded in getting out a number of calculi. Of course we are careful not to cause trauma. In 1 case I had no idea it was possible to get the calculi out. The man had had the calculus for nine years. He had an X-ray plate made nine years ago and there was very little enlargement of the calculus during this time, as shown by the plates we had taken. It was located above the crest of the ilium. We treated him for two weeks and then he passed the stone into the bladder, where it was removed. Another case was a woman who had three calculi in the right ureter, each one measuring 2.5 cm. long by 1 cm. in diameter. They were located about the upper portion of the rim of the pelvis. We advised operation, but she insisted upon trying dilatation of the ureter first, and to my amazement after two dilatations she passed the three calculi.

Dr. A. J. Crowell (Charlotte): Instead of making drawings and showing slides I think I can save time in discussion by showing some of the larger stones we have removed by ureteral anesthesia and ureteral dilatation. I heartily agree with Dr. Bugbee that you must not allow these stones to be impacted too long. If you do, the kidney will be put out of commission. You must also look out for infection. Prolonged manipulation is frequently followed by infection. This is not such a bad thing, however, if you get the ureteral catheter by the stone. This will give drainage for the kidney's secretion, dilate the ureter, and make pelvic lavage with saline or antiseptic solutions possible. In this way permanent damage to the kidney is

averted. It is surprising what large stones can be removed by this method. We believe that from 90 to 95 per cent of the recently impacted stones can be removed by this method.

We probably have persisted longer than we should in our efforts to remove some of these stones by cystoscopic methods, but it is probably safer than to resort to surgery prematurely.

Dr. Bransford Lewis (St. Louis): There is one factor in the cystoscopic method of ureteral stone removal that I believe is not stressed enough. It does not depend altogether on the size of the stone.

Another element of difficulty is the spiculation, or the roughness of the stones. I worked on a ureteral stone just recently, dilating several times, but I could not get the stone, although it was not a large one. Finally I became discouraged and adopted an open operation, and when I got in found the stone far down in the pelvis. With my finger and thumb I wanted to bring it into a seizable location, but I could not move it; and finally I found it was closely adherent to the mucous membrane and covered with spiculae, which explained why it could not be removed. I had to detach it to get it out. The surface of the stone, therefore, has a bearing on this subject and must be taken into consideration when determining our procedure.

Dr. Herman L. Kretschmer (Chicago): It seems to me one fundamental principle was brought out in this discussion, and that is the conservative management of cases of kidney and ureteral stone. I think as urologists we have always been rather conservative in the treatment of stones in the ureter—we have tried non-operative methods such as Drs. Bugbee and Crowell have described.

In some of these cases of stone in the ureter it is primarily a question of size. I think some stones must be handled surgically, but with manipulation quite a number will pass unaided. In a series of 150 cases of stone in the ureter that I went over recently, 25 per cent passed the stone without aid of any sort.

I was glad to hear Dr. Quinby say that stones of the kidney should not be operated on ad libitum. With the recent developments in X-ray technique so that stones are found more frequently, these patients fall into the hands of men who are anxious to operate, and very often patients are operated when they could have been handled by conservative treatment, as Dr. Quinby has said. It is surprising how many patients will pass stones without aid of any kind, a fact brought out by Dr. Leonard many years ago.

Another point is that of recurrence. I agree with most of the men here, I think, that the cause of recurrence of stones is not really recurrence, but is more often due to small spiculae of stone left behind at the first operation.

Dr. Braasch's very excellent paper brings out the question of the conservative operation for stone. Dr. Caulk and others have emphasized the fact that washing out the kidney pelvis helps a great deal. In other words, we are trying to handle these cases conservatively, so that we do not leave any fragments behind, and to clean up infection after the stones have been removed.

Dr. Crowell's paper interested me very much. His is a very old subject. One of the first publications on this subject appeared in the Philosophical Transactions of London in 1805. The early writers on cystinuria called is a disease of metabolism, and called attention to the fact that these people had a rheumatic or gouty "diathesis." I think they were as near right as we are today, because we do not know anything about the real cause. One fact was not brought out by Dr. Crowell, and that is that cystinuria occurs in families. It was my good fortune to run into such a family in which two small boys ages nine and eleven had large cystin stones in the bladder and cystin crystals in the urine; and the rest of the family (except the father, whom I did not see) showed cystinuria. Sometimes they do not show cystin crystals in the urine, but one is able to obtain certain sulphur reactions in the urine. So if you suspect you are dealing with cystinuria and cannot find the crystals it would be well to examine the urine for sulphur.

Dr. GEORGE R. LIVERMORE (Memphis): I am glad to hear Dr. Chute minimize the dangers of nephrotomy over pyelotomy. I have been forced many times to do a nephrotomy when I wanted to do a pyelotomy, because I could not get the kidney up sufficiently to do a pyelotomy. Therefore it is gratifying to find a man of his experience minimize its dangers. I wish he would tell us the kind of tube he uses for drainage.

I am rather surprised of late years to hear the statement made that we ought to leave the large kidney stones alone. Dr. Geraghty read a paper before the last Southern Medical Association meeting on this subject and advised that the large branching stones, those that fill the entire pelvis, be left alone.

The most plausible theory of the etiology of stones, the one that has been worked out the most successfully, is the infection theory, and I am a firm believer in it. That being so, any stone is a potential source of danger. There is apt to be infection carried to the other kidney, followed later by the formation of stone. I do not know that I altogether agree that stones should be left, unless the patient's condition is such that it would jeopardize life to remove the stones. I have an old lady now, seventy-two years of age, who has a large stone in the left kidney. She has infection and sometimes a little temperature. But we carry her along with irrigations and diuretics because we feel sure that it would be dangerous to operate.

In regard to intra-ureteral manipulation of stones, I am heartily in favor of this. I think a great many cases are operated who would have passed the stone if they had had this kind of treatment.

I have devised a little instrument with which I can grasp a stone and change its position. The great difficulty with my manipulator is that it is difficult to get it by the stone as it must do this before it can grasp the stone. This instrument was not devised for the purpose of grasping a stone and pulling it out, but simply to rotate it or change its position, then remove the instrument with the hope that the stone will soon pass on into the bladder.

Dr. WILLIAM F. BRAASCH (Rochester): I like the paper Dr. Bugbee presented on ureteral stones. I think it is high time that someone called a halt on the promiscuous attempts to remove every stone in the ureter by means of manipulation. Without question the pendulum has swung too far. There are definite indications for the surgical removal of stones in a considerable number of patients having stone in the ureter. Although we have always encouraged the conservative treatment of these cases, there are certain ureteral stones that are better and more quickly removed by surgical treatment than by manipulation. In the last few years we have had ten or fifteen patients with ureteral stones who have been subjected elsewhere to repeated attempts at ureteral manipulation with failure. Most of these men were skillful cystoscopists, but in spite of their conscientious efforts, they failed. There are many ureteral stones which require repeated efforts over a period of months, and with unquestionable danger to the patient, in order to remove the stone by conservative methods, when it could be removed by a comparatively simple surgical procedure, and the patient could be out of the hospital in ten to fifteen days. With the surgical technique developed as it is today, there is frequently no need of prolonged manipulation of these stones. I do not wish to decry the efforts of those who favor this method, but there should be a halt called on the use of manipulation in every stone in the ureter.

Dr. JAMES A. GARDNER (Buffalo): I wish to illustrate a case in which we attempt to deliver the stone without operation. There was a diverticulum which was not shown by the X-ray. The patient would have an attack of colic every so often. We were able to pass one catheter, two catheters, and three catheters, feeling that we are dilating the ureter. With the X-ray picture the stone seemed to move, so we were encouraged to try the fourth time, believing we were accomplishing something. There was plenty of room to pass a large catheter, but the stone would not move, so after the fourth time we compared the films and found the stone apparently at different levels. I operated and

found a diverticulum and removed the stone. The X-ray man said the trouble was that the pictures were taken at different slants, so that the stone at one time appeared to be above, and another time down low.

Dr. BENJAMIN S. BARRINGER: Both Drs. Hunner and Bumpus have given papers in New York on the prevention of stones, and it seems to me their work is of great importance. Dr. Bumpus has worked from the mouth end, and his work on animals and patients has suggested that the relation between focal infection and stone formation is important. I think that should be carried out in cases where there is operation to remove stone. Dr. Hunner's work is familiar. I believe after these stones are removed a certain amount of dilatation might prevent further formation of stones and certainly should be carried out.

Dr. ARTHUR L. CHUTE (closing): I want to protest against too conservative treatment of renal stones. I have seen kidneys go all to pieces while people were waiting for what they considered a definite indication for operation. I have an example of this now in a woman from whose right kidney I removed two years ago a large stone, doing a pyelo-lithotomy. She had a reformation of stone in that side and I operated a month ago, doing a nephro-lithotomy this time. On her other side she has a dead kidney, due to a neglected stone, and at times she runs a temperature of 102 to 104. She has an almost clear urine on the operated side, but from the other side one sees moulds of pus. This is an example where conservative treatment was carried too far.

Doctor Livermore asked what kind of tube I use to drain a kidney. Ordinarily I use a small rubber tube with rather firm walls about $\frac{1}{4}$ to $\frac{5}{8}$ inch in diameter, making a fish-tail opening in the end.

Dr. RICHARD F. O'NEIL (Boston): I was very much interested to hear the trend of the discussion in regard to recur-

rence—that in many cases it is not a true recurrence but due to fragments left after operation. I am sorry Dr. Barney is not here because he has done considerable work along these lines. On looking up our cases at the Massachusetts Hospital he came to the conclusion that some of the cases of so-called recurrence were undoubtedly due to the leaving of small fragments. It seems to me Dr. Quinby's addition to the technique has great interest and value.

Dr. R. C. GRAVES (Boston): For the past year and a half, with members of Dr. Folin's department of biological chemistry, I have had under observation a patient who has cystinuria. She came to the hospital with typical renal colic which was suggestive of calculus, but the X-ray plates were repeatedly negative. A pyelogram at first seemed to show a normal condition on the side of the pain, but closer inspection found a small area of decreased density which looked like an air bubble. Thinking it probably the outline of a shadowless stone we operated and removed from the pelvis of that kidney a calculus which subsequently proved to be pure cystin. (See Annals of Surgery, April, 1922.) We then studied the patient very carefully over a considerable period of time, and the results of this study will appear in the Journal of Biological Chemistry.

A further interesting point is that, although the patient before operation passed numerous small calculi, presumably of the same material, and since operation has passed showers of small stones, she has never had cystin crystals in the urine.

We found that 8 members of the patient's family had this familial condition of cystinuria, although the patient herself was the only 1 of the 8 who suffered from the formation of stones. We know very little about the association between cystinuria and calculi. The element of infection cannot be held responsible because this particular patient had no history of infection before her calculus formation, whereas one of her sisters had a heavily infected urinary tract, without stones.

Cystinuria, as has been said by the previous speaker, is a defect of sulphur metabolism, in which cystin passes into the

urine before it is completely metabolized. The condition may be held in abeyance by rendering the urine alkaline and keeping it so, and also by placing the patient on a low protein diet. The difficulty in our case lay in persuading the patient to take sufficient sodium bicarbonate over a long enough time to render her free from discomfort. She was perfectly comfortable as long as she followed her dietary rules, and took sodium in sufficient amounts. As soon as she neglected the program she began to pass showers of small cystin stones.

Dr. Joseph Hume (New Orleans): We have a doctor who had a diagnosis of stone made in 1876. I have recently examined this old gentleman and in seventy-three years his urine is still free from cystin. Although it shows albumin, casts and blood, and the stone has not appreciably increased in size. Another case is an old Italian, seventy-five years of age, who passed stones when he was twenty-seven, and has passed over 1500 since that he has kept count of. He did not count anything smaller than buckshot, but he could pass stones as large as 32 calibre bullets.

As regards the important question of recurrence of stones, it seems to me strange that Dr. Braasch, who has such an immense amount of material at his disposal, should not make the distinction between recurrence in those cases where there is no infection and recurrence where there is infection. We cannot yet understand the rôle of focal infection in kidney disease. We have cases of early stone where cultures from the kidney show absolutely no infection, and that type of case seems to me to be distinct from cases where there is infection. In the infected type there is a peculiar condition in regard to the bacteriology of the infection. If you deal with those urines that contain the staphylococcus, there is nearly always a recurrence, whereas with the colon bacillus the ratio is not so great.

There is no question that the formation of stones is a question of metabolism and that the metabolic condition changes with the individual. For instance, you take people who never had stones, and give them a compound fracture or something of that

kind that will keep them in bed, and at the end of that period you will get stones. Then we have had a large number of people who had tuberculosis who never had a history of stones before, but in their eagerness to conquer tuberculosis by forced feeding they develop a history of stones. I think therefore there must be a period when something goes wrong in the internal chemistry, when you do not handle food products as you should, and you thereafter have primary stones. And that is the point—that in a young man it is advisable to wait a long time and give nature a chance to adjust herself. If Dr. Braasch analyzes his statistics he will find a large number between twenty-five and thirty in which two or three operations were done, with recurrence. Therefore with small stones you should wait probably two years before you operate.

Dr. WILLIAM E. LOWER: I think we ought not to forget the lesson taught us last year by Dr. Hinman when he demonstrated from his researches in obstruction of the ureter on one side what happens to the kidney on the side of obstruction, and how quickly the kidney on the other side takes on compensation. If the obstruction is permitted to continue for any considerable length of time, neither the kidney function nor the dilatation of that side is restored to normal, as the other kidney will continue to do the work, leaving the previously obstructed side to play a more or less negative rôle. Personally, I do not like to bring the kidney out into the wound if it can possibly be avoided; in many of these cases, the stone can be removed through the pelvis without bringing the kidney to the surface. I am sure any unnecessary manipulation of the kidney is unwise as far as function is concerned.

Dr. W. C. QUINBY (closing): Certainly the Association is to be congratulated on the variety of discussion of this important subject.

Dr. Townsend asked about the technique of making these films. By our present method the kidney need not necessarily be brought to the surface of the body, for the film is so small

that it can be tucked down behind the organ, which, as you see, had been done in this case. The film is covered with a little towelling jacket first, which in turn is covered with rubber to keep out the blood and other fluid.

In regard to what Dr. Lower has said, I think less manipulation is necessary where you can put the film down behind the kidney.

Dr. Caulk emphasized what I tried to bring out in my paper, namely, that in a large percentage of operations for renal stones I personally prefer to make a double opening, one into the pelvis and one through the cortex, using a blunt instrument, not a knife, thus pushing the stones up and delivering them without the slightest trauma to the stones themselves. I should have said that in cases where there is renal sand it has been our custom to insert a smooth catheter and wash out the wound.

We have had the opportunity in a few instances to see some very interesting examples of the spiculated stones which Dr. Lewis has mentioned. In fact, I have a rather unusual picture showing such stones.

I hoped Dr. Graves would recall to your minds a very interesting report which he has already made of a case of cystin stone. In this case, at least, the cystin calculus cast no shadow whatever in the X-ray plate. (The report of this case appeared in the Annals of Surgery for April, 1922.) In other words, if the cystin is absolutely pure, it apparently does not cast a shadow.

I agree with Dr. Livermore that large stones should usually not be removed. However, I mentioned in my paper that each case of stone should be judged individually. There is no general rule, no royal road to glory, in this disease. Frequently large stones should be left; but sometimes they should be removed.

I was delighted to hear Dr. Braasch say that too many ureteral calculi have been manipulated. I have seen such instances as he has spoken of. I think all of you can remember cases where you tried to dilate the ureteral orifice, and can remember the amount of demonstrable change which occurred after such dilatation, either with dilators or with catheters. There is a very distinct amount of trauma which must follow such manipulation. There is bullous edema, swelling, submucosal hemor-

rhage, and it is a question as to how far one should subject an ureter to that sort of treatment as against the clean-cut operation of simply opening the ureter over the stone, picking it out, and sewing up the wound. In such instances the patient has gone home in fourteen days.

Dr. WILLIAM F. BRAASCH (closing): Relative to the delivery of the kidney with renal fluoroscopy, there should be no harm done in bringing the kidney out of the wound as far as is practical. We have never observed any ill results in the several hundred cases where this method has been employed.

I am not in a position to discuss the relative merits of making a diagnosis by means of films or by the fluoroscope. However, it is apparent that the exact localization of the stone is more accurately and expeditiously accomplished by fluoroscopy. Nevertheless, there are undoubtedly cases where the film method would be a valuable adjunct.

In regard to the etiology of the stone, I brought this question up before the Southern Medical Association last year. While there are several probably etiologic factors involved, nevertheless, I believe that the most important one is the infectious factor. Dr. Rosenow recently demonstrated the possibility of direct bacterial etiology in the formation of stones. In his experiments he reported that in 5 of 6 dogs inoculated with streptococci taken from a patient who had a repeated stone-forming tendency, stones were found in the kidney. This was corroborated in several subsequent experiments. On the other hand, it must be recognized that there are patients who have no apparent infectious etiology and in whom it would be more logical to conclude that chemical factors are probably predominant.

Dr. Hume said he found urine uninfected in some of his patients. It is, of course, possible that infection may be present in some of these cases even though neither pus nor bacteria are found, and which would well be the etiologic factor Dr. Keyser and I are about to report a number of patients who have passed numerous stones at short intervals over long periods of time. We have been able, in the last year, to stop the formation of stones in several of these patients by rendering the urine

alkaline. I am under the impression that alkalinization of the urine is of value and should be tried in these stone forming kidneys.

The point that Dr. Crowell brought out probably holds good in most cases. It is our custom to remove all possible foci of infection as a routine procedure in every case of stone. It is evident that in some cases we are removing tonsils and teeth needlessly, but it is impossible to differentiate accurately between those patients where it is necessary and those where it is not.

Certainly the last word has not been said on this subject, and I hope that this discussion will help to solve the problems involved in the causes of stone and stone recurrence.

Dr. HUGH H. YOUNG: A few years ago it was brought out that most renal calculi were oxalate of lime, which is not soluble in alkaline, and that our treatment should be acid rather than alkaline therapy. What is the latest word on that?

Dr. W. F. BRAASCH: We have not made a routine study of the stones from a chemical standpoint, but in a large number calcium oxalate is predominant. I am referring particularly to the type of stone occurring in patients with repeated stone formation.

Dr. JAMES PEDERSEN (New York City): At what age is stone likely to recur?

Dr. BRAASCH: Between twenty and thirty-five, I think.

Dr. A. J. CROWELL (closing): I did not read the history of our case reported in this paper; therefore, I will answer one or two questions which have been asked.

First, with regard to the shower of stones. I will say that this young lady passed what she termed a "shower" of stones, 20 to 30, several times before coming under our care.

Second, with regard to the family history. We have under our care at present a sister of this young lady who had one kidney removed, the right, on account of extensive infection and

a stone in it. She now has 2 stones in her other kidney. We have been unable to find cystine in the urine, chemically or microscopically, but she has been taking bicarbonate of soda for some time. This may have something to do with our inability to find cystin in solution or crytals. Her grandfather died of kidney colic. No X-ray pictures were taken of him to ascertain if stones were in the kidney.

Third, as to the shadow, I will say that Dr. Shipley of Baltimore removed stones from each of her kidneys in June and November of the previous year. They were analyzed at the University laboratory and found to be cystin. The X-ray shadows before removal were very distinct, and you see ours are very definite. Our laboratory man analyzed the stone I show you, and says it is made up largely of cystin. Therefore, our X-ray and laboratory reports coincide with those of the University.

In looking up the literature on the subject, we were unable to find any demonstration of the disintegration of kidney cystin stones, and because of this fact felt that this case should be recorded.

Research may find a solvent for stones of other compositions and offers a fertile field for such investigation.

Dr. Henry G. Bugbee (closing): I would like to say that I thoroughly agree with those who have discussed these papers, especially in regard to the keeping up of intra-ureteral manipulation of calculi for a long period of time. None of the calculi that we have removed by open operation have been calculi that have been manipulated for any length of time. They were calculi that we felt could not be passed and were therefore removed. As I stated in my paper, we removed three calculi by open operation during the last month, we have one patient on whom I expect to operate next week, and the third patient going into the hospital. That means six patients in two months, all of whom require open operation. On the other hand, I might go six months and not find it necessary to remove one by open operation. Certainly the very best judgment must be used in these cases.

SECOND DAY, MAY 18, 1923

SUPRAPUBIC CYSTOTOMY AS A DIAGNOSTIC AND THERAPEUTIC MEASURE IN CERTAIN CASES OF RENAL TUBERCULOSIS

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I believe it rather generally accepted that tuberculosis of the urinary tract is primary in one kidney. This statement does not consider tuberculosis of the seminal tract, which should be considered separately, and it is made with the understanding that in a large percentage of cases, healed or quiescent or perhaps active tuberculous lesions may be demonstrated in remote parts of the body. I believe, too that it is generally accepted that the treatment of renal tuberculosis is surgical, provided that there are no active, remote lesions, that the patient's general condition warrants a major operation, and that we can demonstrate that the other kidney is competent to carry the entire burden of renal function.

In the great majority of cases all these items can be accurately checked up by the ordinary means at our disposal; cystoscopy, ureteral catheterization, radiography, and the usual laboratory procedures. However, it is a fact that many if not most of the cases which come under our care have extensive lesions of the bladder; ulceration, contraction, limited bladder capacity, etc. This of course adds materially to the difficulty of cystoscopy, and many patients require repeated examinations, usually with some form of local or general anesthesia. Occasionally a patient presents himself in whom it is absolutely impossible, because of limited capacity and inability to wash the field free of blood, pus, and tenacious mucus, to catheterize the ureters or even

get a satisfactory view of the bladder. This at least has been my experience, and there have been 3 such cases out of a total of 55 cases of tuberculous kidney observed at my clinic at the Brooklyn Hospital during the past five years. One of these, the first of the 3, following his fourth cystoscopy done in as many weeks, under prolonged general anesthesia and with repeated irrigations, developed symptoms of urinary extravasation, and in spite of extensive and what appeared to be adequate drainage, died. The autopsy revealed the body of a young well-developed adult; there was a small rent in the left postero-lateral wall of the bladder at the bottom of a tuberculous ulceration; there was extensive extravasation of urine deep in the pelvis and extending up along the course of the ureter; the tissues were necrotic; the kidney on that side showed well advanced tuberculous lesions; the opposite kidney was perfectly sound, and careful search failed to reveal any other focus of tuberculosis in the body. This incident was tragic and deplorable but it demonstrated rather emphatically to my mind that there is a mortality, small of course, but nevertheless a mortality, attached to cystoscopy on tuberculous bladders. At any rate, cystoscopy in such cases may assume the proportions of a major operation. Anesthesia of some form is usually essential, and that item alone is not without risk. Any form of inhalation anesthesia, particularly if prolonged or repeated many times, is of course objectionable; sacral anesthesia is not dependable, and local anesthesia does not work. Given, then, such a case, in which two or more competent cystoscopists have been unable after a reasonable trial to perform a satisfactory cystoscopy, what shall we do in order to effect a complete urological diagnosis? It is true that a good radiograph may often give us a lead. Braasch has pointed out certain rather characteristic findings. However, they are by no means constant, and the X-ray certainly gives us practically no information about the condition of the other kidney. Subjective symptoms are often misleading. In one of the two cases reported below these signs pointed to the affected organ, while in the other case they pointed rather definitely to the healthy side. Before the

development of the modern cystoscope and I believe, occasionally since that time, several methods have been suggested for the purpose of solving the problem; the segrator, laparotomy with exploration of both kidneys followed by immediate nephrectomy on the evidence thus obtained; lumbar incision on one or both sides with or without aspiration of urine from the renal pelvis; exposure of one ureter in the groin, applying a temporary ligature while urine from the other side is collected from the bladder, etc. In my opinion these procedures have but little to recommend them and much to be said against them.

In 2 cases, reported below, I performed a suprapubic cystotomy, passed catheters through the urethra and guided them into the ureters through the open bladder and in this way obtained all the information required. When the problem first presented itself to me I could find no reference to such a procedure in a casual survey of readily available literature, and felt that I was treading upon new and rather uncertain ground. In preparing this paper I had made for me by the Literary Research Bureau of the American College of Surgeons a careful review of the literature, and found as usual that "there is nothing new under the sun." However, the references were few in number, and a careful search covering the literature for the past fifteen years developed only four articles published during that period. These were all by French writers.

Marion (1) in a clinical lecture published in 1912 recommends it. He credits Albaran as being the first operator to employ it. He notes the fact that it may be difficult of performance and also emphasizes the point that in addition to its diagnostic value it has the added advantage of putting the bladder at rest. At the conclusion of his address he catheterized through her bladder the ureters of a young woman. When he opened the bladder he found ulceration of the entire trigone and neck. In spite of this catheterization was relatively easy. Contrary to his previous opinion it was the left and not the right kidney which was diseased. The ulcerations were treated with the thermo-cautery and the bladder drained. Left nephrectomy was planned for a later date.

Carlier (2) writing in 1912, considers this procedure of value in cases where it is impossible to catheterize the ureters in the ordinary way, and has employed it in certain cases. He cites two objections to it, that it may be extremely difficult and second, that the suprapubic fistula may be slow in healing. He reports 2 cases requiring two and four months respectively. He perfers lumbar incisions, beginning with the supposedly healthy kidney and immediate nephrectomy on the evidence thus obtained. Personally I doubt very much if the information obtained in this way is, in any sense, conclusive or reliable.

Pasquereau (3) writing in 1912 reports 1 case in which he feels that nephrectomy alone would not have been enough to have relieved the symptoms. He catheterized the ureters through the open bladder which he found very extensively diseased. There was immediate relief of symptoms and nephrectomy was performed later. Following this, he expected the suprapubic fistula to heal. It did not heal and the patient was finally discharged with a permanent suprapubic drain. Both the operator and the patient seemed quite satisfied with this arrangement.

Cathelin (4) writing in 1918 states that in 50 per cent of the cases of renal tuberculosis it is impossible to catheterize the ureters by the ordinary means. He mentions catheterization through the open bladder only to condemn it, citing as his objection the technical difficulties and the danger of a permanent fistula. He recommends as an alternative one of three measures: (*a*) the segregators: (*b*) lumbar incision with aspiration of urine from the kidney pelvis; (*c*) temporary ligation of the ureter through a groin incision on the supposedly diseased side and collection of urine through the bladder from the supposedly healthy side. With all due respect to Cathelin I am by no means convinced of the wisdom of his choice of procedures. I believe that suprapubic cystotomy with catheterization of the ureters through the open bladder is entitled to a place as a diagnostic measure in certain cases of renal tuberculosis. I should entertain this opinion if it served no other purpose than that of a diagnostic procedure. There are however, two other functions which appear to me to add materially to its value. First,

it puts the bladder and the patient himself at rest, and enables us to get him in better shape for nephrectomy later. A patient who is urinating night and day every twenty minutes, with each act of urination accompanied by pain, is not an ideal candidate for a major operation. Second, it gives us an opportunity to treat the bladder lesions locally and perhaps, in this way, ameliorate and shorten the extremely protracted bladder convalescence so often noted following nephrectomy for renal tuberculosis. In my cases I swabbed the diseased areas with pure carbolic acid followed by alcohol. Other, perhaps better, methods might readily be suggested. These latter items lead me to feel that with a little more experience one might broaden the indications for this procedure to include not only those cases in which satisfactory cystoscopy is impossible but also those cases in which there is an extreme degree of vesical distress and in which cystoscopy, while possible, would be extremely difficult.

Four criticisms very naturally suggest themselves:

1. It is a confession of weakness and perhaps lack of cystoscopic skill. That may be true, and yet I believe that some of these cases will baffle the most skilful among us.

2. It is an added operation with added attendant risk. In my opinion cystoscopy may be and often is attended by quite as much shock and discomfort as is cystoscopy: it is not entirely devoid of risk, and furthermore, it does not always accomplish its aim.

3. The operation may be difficult or impossible to perform. I doubt if it should ever be impossible. The fact that it may sometimes be difficult is hardly a valid objection provided the procedure has merits. A minor point of technique which I have found of value is to have an assistant pass an endoscope with a light in the distal end, through the urethra. I believe that this provides better illumination than can be obtained by reflected light or light-carrying retractors, and adequate illumination is an important factor in the operation.

4. That the suprapubic fistula will not heal. A consideration of this possibility is, of course, of extreme importance. And the merit of the procedure might well be decided upon this point.

In one of my patients the wound healed promptly and kindly. In the other patient the healing was protracted because of certain complications but was eventually complete. It is my belief that while the closure might be delayed in some cases, that all or certainly most of them would eventually heal. I believe that in those cases in which healing is delayed or in which a fistula might persist, would occur in bladders so badly diseased that the bladder symptoms persisting after nephrectomy would be almost if not quite as distressing as a suprapubic fistula.

There follows a very brief résumé of my 2 cases.

Case 1. A male, aged twenty-nine, admitted to the hospital December 26, 1917. In good health until February 1916, at which time he passed blood in his urine. Since then he has had backache, more particularly in the right loin. He has had dysuria and frequency, gradually getting worse until now he is urinating every half hour, day and night. He has lost 20 pounds in weight during the past year.

Examination. The chest appears clear. The right kidney is palpable and tender. The left kidney cannot be felt. The urine contains pus, blood, and tubercle bacilli. During an observation interval of twenty-six days he was cystoscoped on four different occasions, twice with gas-oxygen anesthesia. At no time was it possible to catheterize either ureter or to obtain a satisfactory view of the bladder. On January 21, 1918, a suprapubic cystotomy was done under gas-oxygen. The whole trigone and bladder base was covered with tuberculous ulcerations. These were swabbed with pure carbolic acid, followed by alcohol. The ureteral orifices were readily located and a catheter was passed easily to the kidney pelvis on the right side. On the left side an obstruction was encountered in the intramural portion of the ureter, but was passed with a little manipulation. The suprapubic wound was partially closed in the usual manner with a rubber drainage tube in the bladder. Clear urine and normal 'phthalein were obtained from the right side; from the left side the urine was loaded with pus and tubercle bacilli and no 'phthalein was excreted in one hour.

The relief from symptoms was immediate and striking. The patient had restful nights and gained rapidly in weight, color, and general strength.

On February 4 (two weeks after the cystotomy) a left nephrectomy was done. The kidney showed advanced and extensive tuberculosis. Operative convalescence was uneventful.

On February 12 (eight days after nephrectomy, twenty-two days after cystotomy) he was voiding most of his urine through the natural channel. February 16 (four days later) the suprapubic wound was closed. February 25 he was discharged with a small sinus in the kidney wound.

April 1: Kidney wound is broken down throughout nearly its whole extent. He urinates every two hours by day and twice at night.

July 1: The kidney wound is closed. He is urinating every three hours by day and once at night. There is still pus in the urine.

February 20, 1919: Admitted to medical ward with a story of headache, chills, and fever, for two weeks. He reports that he has been very comfortable insofar as his bladder is concerned, except that he has been obliged to arise once at night. There is a suggestion of rigidity in his neck muscles. The cerebrospinal fluid shows a marked increase in cell count, and tubercle bacilli. Death occurred on March 6, 1919, from tuberculous meningitis.

While the end result in this case was unfortunate, I feel it was no reflection on the procedures employed. The relief from symptoms in the interval between his cystotomy and his nephrectomy was most striking, and the rapidly progressive improvement in bladder function following his discharge from the hospital was very different from the tardy progress so often noted in these cases.

Case 2. Male, aged twenty-five, admitted to the hospital September 22, 1922. Family and previous history irrelevant. For the past year he has felt below par, tires easily, and urinates twice at night. For the past month, dysuria and frequency rapidly progressive. Nocturia: six. Two weeks ago terminal hematuria. He now urinates every twenty to thirty minutes day and night. He has been cystoscoped twice in the out-patient department with indefinite findings.

Examination. There is dullness and broncho-vesicular breathing over the right apex, extending to the third rib. There are no râles, no cough, and no sputum. The chest lesion is evidently healed. Neither kidney is palpable, but there is some tenderness at the left costo-vertebral angle. The urine contains pus, blood, and tubercle bacilli. The Wassermann reaction is negative. Phthalein, 40 per cent. Blood chemistry: Urea 30; creatinin, 2.25; sugar, 114; CO_2 combining power, 71.9.

Radiograph: The right kidney is enlarged. The left kidney is not clearly seen. At the right side just below the sacral promontory, apparently in the course of the ureter, there is a vague, indefinite shadow about 1 cm. in its longest diameter. This suggests a ureter calculus.

September 23, 1922: Cystoscopy under gas-oxygen anesthesia. This was very unsatisfactory; neither ureter orifice could be seen nor could one get a very satisfactory view of the bladder wall, except to get the general impression that it was extremely ulcerated.

September 29, 1922: Cystotomy under gas-oxygen anesthesia. There is extensive ulceration involving almost the entire bladder mucosa. This was swabbed with carbolic acid, and followed by alcohol. The ureter orifices were identified with some difficulty. A No. 5 catheter passed readily to the kidney pelvis on the right. A catheter will not pass on the left, and a fine probe was passed 2 inches into the left ureter, where it is definitely arrested. A faint trickle of very cloudy urine is seen emerging around the probe. Wound partially closed with rubber tube in bladder. Urine from right side contains a few pus cells, no tubercle bacilli. Intramuscular 'phthalein appears from the right side in nine minutes. There is no 'phthalein from the left side (collected from the bladder in hour).

The day after operation the patient developed an acute pyelitis on his right side, with chills and fever, and tenderness over the right kidney. This persisted, gradually diminishing for one week. The following week he was very comfortable and occasionally slept all night.

October 13, 1922 (two weeks after cystotomy): Left nephrectomy. This was particularly difficult. The kidney was double normal size, high up under the ribs, and very adherent. About 5 inches of much thickened ureter was removed with the kidney. It had been our intention to remove the entire ureter but at this stage of the operation he was showing considerable shock and the ureterectomy was abandoned. Convalescence was rather stormy. Both wounds became badly infected.

December 4, 1922: There was a severe chill and temperature of 104°, scanty urine, and much pain and tenderness over the right kidney.

December 6, 1922: Total anuria.

December 7, 1923: Cystoscopy with gas-oxygen anesthesia. It is of interest to note that on this occasion, in spite of his stormy time the bladder was sufficiently improved so that it was a relatively easy matter to identify and catheterize the right ureter. The catheter was passed to a point apparently near the sacral promontory where it met a definite obstruction. This was finally passed and there followed a gush of cloudy

urine through and around the catheter. There then occurred a fairly prompt subsidence of symptoms, the temperature reaching normal five days later, where it remained. On December 9 the patient passed a calculus of the size and shape noted in the radiograph.

Convalescence after this was uneventful. Discharged on January 22, 1923. Kidney wound granulating. He is voiding all urine by day, but there is a little leak from the suprapubic fistula by night. This was entirely closed three weeks later. The closure had required fourteen weeks.

April 2, 1923: Both wounds healed. Has gained 25 pounds. Is working. Urinates every two hours by day, twice at night.

Obviously this patient had a very stormy time, but I believe in spite of and not because of the methods followed. His complicating right ureter calculus and pyelitis were, of course, important factors in retarding his recovery. Notwithstanding all this I believe that he is further along with his bladder convalescence than he might have been had he been handled in a more orthodox manner.

In conclusion I submit for your consideration: First, that in cases of renal tuberculosis where it is difficult or impossible to catheterize the ureters in the usual manner that suprapubic cystotomy is the method of choice for the purpose of making a complete diagnosis. Second, because of certain therapeutic advantages made available by the procedure, increased experience may broaden the indications.

REFERENCES

(1) Marion, G.: Proceedings to be followed in renal tuberculosis in cases in which the condition of the bladder prevents catheterization by the natural route. J. d'urol. med. et chir., Par., 1912, i, 599–610.

(2) Carlier: Diagnosis of the operability of renal tuberculosis in cases not permitting catheterism of the ureters. Assn. franc. d'urol. Proc.-verb., Par., 1912, xvi, 574–591.

(3) Pasquereau: Cystostomy combined with nephrectomy in the treatment of advanced stages of renovesical tuberculosis. Assn. franc. proc.-verb. et mem., Par., 1912, 675–676.

(4) Cathelin, F.: What should be done in renal tuberculosis in cases where ureteral catheterization is impossible? Urol. and Cutan. Rev., 1918, xxii, 526–527.

TWO UNUSUAL BLADDER LESIONS

ALEXANDER RANDALL

In a course of post-mortem studies on bladders and prostates, I came upon two very unusual pathologic conditions of the bladder wall not before seen in over one thousand specimens. I preserved and mounted these specimens for future study. The call of the secretary for this meeting was the stimulus awaited to make me undertake their diagnosis and for this reason the title of "two unusual bladder lesions" was tentatively placed. Three months' work finds me in a very embarrassing position. I still have my specimens, and they still remain interesting, but likewise they still remain undiagnosed. Hospital histories, histological and bacteriological studies, personal interviews with living relations and study of the literature have not elucidated the problem. I present them for your observation and criticism, chagrined at my own impotence in being unable to solve their secrets, but realizing that the enigma that they present also provokes the interest in their being.

CASE I. GENERALIZED HEMORRHAGIC GANGRENOUS PAPILLARY CYSTITIS

Case I. G. W. D., serial number A 4227, aged forty-two years, laborer. Entered men's Psychopathic Department, Philadelphia General Hospital, December 22, 1921. Died December 28, 1921.

Diagnosis. General paresis of insane.

The patient was admitted to the hospital by police patrol in a very weakened condition and unable to walk. The police state he had been found walking about the streets unemployed, talking to himself; claiming to have billions of dollars; owning several theatres and living at the B——S hotel, in room 79.

During his stay in the hospital it was impossible to obtain any further information regarding his past or the existence of any relative or friends. He is reported to be a laborer by occupation; forty-two years of age.

On admission his bladder was markedly distended and he was catheterized in the receiving ward.

Physical examination. Small, emaciated male, lies curled up in bed on his left side; resists any change of position. Muscles are stiff and tremulous. Eyes are tightly closed. Breathing stertorous; pupils are large and unequal and fixed; lungs were found to be normal throughout; heart is regular, no murmurs demonstrable. Blood pressure: systolic 120, diastolic 80. Abdomen negative; extremities very stiff, hard to relax; reflexes all present except patellar.

December 24, 1921: Patient has been in ward two days, continues to have grandiose ideas, and no further change in physical condition. This day at 6:00 p.m. he became unconscious after eating his evening meal.

December 26, 1921: Patient remained in comatose condition for thirty-six hours. Regained consciousness today and talked, remarking on the Christmas decorations in the ward. Gradually sank back into comatose state and is decidedly weaker. Patient is partially incontinent.

Urinalysis: Alkaline; specific gravity 1.022; sugar and albumin negative; leucocytes 10 to 15 per high-power field.

Spinal fluid Wassermann test: Plus 4 on all antigens.

Colloidal gold curve: 555555 4331. Globulin increased: 18 cells per cubic millimeter.

December 27, 1921: Patient remains in comatose state; is incontinent. Urine is definitely hemorrhagic.

December 28, 1921: Patient growing very much weaker; Cheyne-Stokes breathing; pulse just palpable. Died late this afternoon.

Autopsy notes. Gross anatomical diagnosis. Heart: Chronic aortic and mitral endocarditis. Aorta: Atheroma. Sclerosis of renal and splenic arteries. Lungs: Atypical lobar pneumonia; acute fibrinous pleuritis; acute bronchitis—left. Kidneys: Parenchymatous degeneration; acute pyelitis—right. Bladder: Papillary and hemorrhagic cystitis; dilatation. Stomach: Chronic catarrhal gastritis. Liver: Congestion. Brain: Cerebral edema; convolutional atrophy.

Detailed description of kidneys and bladder from post-mortem protocol as follows:

Kidneys: Each organ weighs 125 grams and measures 10 by 4 by 3 cm. The organs are soft. The surfaces are smooth and the capsules strip readily. Incision shows a moderately pale cortex 7 mm. thick, which appears rather narrow, but is uniform and apparently not shrunken. The pelvis of the right kidney is moderately inflamed, having numerous areas that are red in color.

Bladder: Is extremely large and the entire wall is dark reddish in color seen from the exterior. The inner surface with the exception of

the trigone is intensely dark red in color and is dotted throughout by small reddish grey projections a few millimeters in diameter; these projections are quite firm, as though they are growths of some duration, and therefore appear older than the hemorrhage which extends through

FIG. 1. CASE I.

No. 6449 B. Aged forty-two. Clinical diagnosis: General paralysis. Anatomical diagnosis: Chronic endocarditis, broncho-pneumonia with pleurisy, chronic interstitial nephritis.

Specimen: Generalized hemorrhagic gangrenous papillary cystitis, probably syphilitic.

the entire wall of the organ. Just what these papillary masses are is difficult to say; they appear to be solid papillary growths."

Histological diagnoses. Lung: Bronchopneumonia. Kidney: Nephritis, chronic interstitial. Bladder: Cystitis, chronic hemorrhagic. Stomach: Gastritis, chronic catarrhal. Brain and cord: Arteriosclerosis; pial thickening; dilatation of the ventricles.

Bacteriological notes. Culture of heart's fluid, sterile.

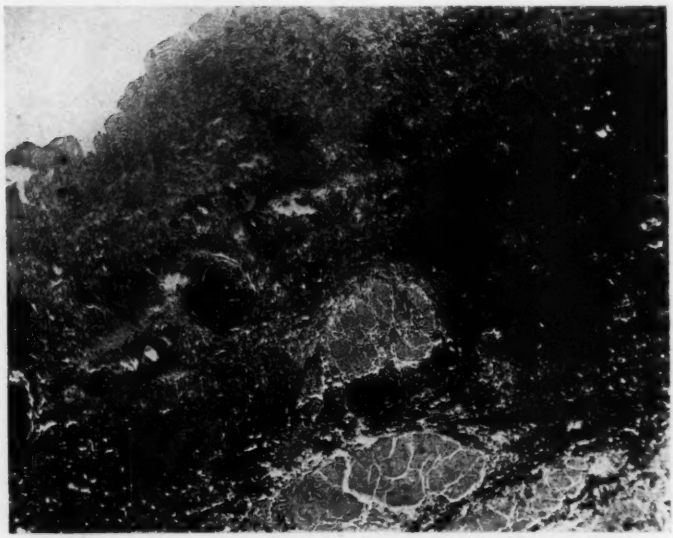


FIG. 2. CASE I. MICROPHOTOGRAPH SHOWING HEMORRHAGE INTO MUCOSA AND MUSCLE WALL OF BLADDER. (× 69)

Description of specimen. The prostate and posterior urethra are normal; bladder of normal size and the thickness of its muscle wall is likewise normal. The entire mucous membrane lining of the bladder with the marked exception of the trigone and a small portion of the bladder floor back of the trigonal bar, is the seat of a generalized papillary hemorrhagic cystitis. Its surface is studded with fine seed-like nodules giving the roughened appearance of a cow's tongue. Its color is dark mahogany brown. The bladder wall throughout its entire thickness is of the same

color, is not friable nor gangrenous. The impression given is of a condition of certainly some weeks duration and not the usual ante-mortem or post-mortem change that has been frequently encountered.

Microscopic pathology. (Dr. W. P. Belk.) There is marked hemorrhage, which has destroyed the mucosa, and is well marked in the muscle coats as far as the peritoneum. Small islands of mucosa may be seen in the hemorrhagic mass. These are entirely necrosed. There is only a little cellular infiltration, chiefly of large mononuclear cells, with a few lymphocytes and polymorphonuclear leucocytes. There are no eosinophiles. Giemsa's and Gram's stains show no bacteria, and stains for tubercle bacilli are negative. No ova are to be found after a very careful search of sections from several areas. There is very little evidence of inflammation, and none of any neoplastic change.

Comment. The outstanding points in the history and post-mortem examination of this case are, (1) male, (2) age forty-two years. (3) paresis, (4) positive Wassermann, (5) positive colloidal gold curve, (6) incontinence, (7) hematuria, (8) catheterization (9) right hemorrhagic pyelitis, (10) pneumonic death.

(It is to be regretted a more detailed description of the condition in the right kidney pelvis was not made.)

The patient's sister was found and interrogated. She stated that the patient was born in Philadelphia, had worked as a watchman up to the time of his commitment to the hospital; had never travelled in tropical countries, not even about the United States.

One's first thought is that this represents a stage, early or late, of so-called hemorrhagic cystitis. Having seen, in over a thousand autopsies all types of cystitis, from ante-mortem and post-mortem changes, I can only reply that this specimen stands alone and bears no resemblance to the ordinary hemorrhagic cystitis from catherer or terminal ante-mortem infection or trauma, and its generalized involvement negatives such a diagnosis. One's second thought would probably be that it was the effect of some irritant caused by catheterization, but the lack of involvement of trigone and posterior urethra should exclude such

an hypothesis. Third, an effort was made to rule out parasitic disease and with a histroy of residence only in and about Philadelphia with negative histological studies it is fair to conclude that such was not the etiological factor. Fourthly, neoplasm was proven histologically to be absent.

The diagnosis will have to be left as generalized hemorrhagic gangrenous papillary cystitis of either syphilitic or circulatory origin.

CASE II AND III. TWO CASES OF VESICAL RUPIA OR RUPIAL CYSTITIS

The second specimen presents an entirely different appearance with the following history and examination.

Case II. L. T., serial number J 7312, aged sixty-four years, white, laborer. Entered the Philadelphia General Hospital, December 1, 1921. Died January 8, 1922.

Complaint. Shortness of breath.

On admission, the patient was slightly irrational; laboring hard for breath with at times typical Cheyne-Stokes respiration.

Family history and past history. Unobtainable. (N.B.: The patient's daughter was interrogated in subsequent investigation. She states the patient was born in Philadelphia and had never travelled further than Atlantic City. He had been an inmate at the Philadelphia Home for the Indigent for a number of years, and from thence was sent to the Philadelphia General Hospital.)

Present illness. When asked the duration of his illness, the patient replies between gasps with statements that are made at random, and at times incoherent. Apparently he took to his bed about ten days ago.

Physical examination. Patient resists all effort to examine him, striking at the physicians, at times kicking and biting. His eyes are staring; pupils unequal and irregular and sluggish to light. There are no gross changes found in his lungs except for a few crepitant râles at both bases. The heart is extremely irregular; sounds are of poor quality with probably a split first sound. The radial arteries are very calcareous; pulse impalpable. Abdomen: Spastic, no abnormality detected. Patellar replexes active.

Blood pressure: Systolic 165, diastolic 110. December 5, 1921. Patient has shown little change. Phthalein test gives 3 per cent at the end of one hour and forty-five minutes. Patient has been partially incontinent; he has developed a hacking cough with blood tinged sputum.

December 7, 1921: More complete examination of chest now possible. Sounds of fibrinous pleurisy in lower right chest cavity appear. Cardiac arrythmia present, with distant second sounds and a systolic murmur. Spinal fluid Wassermann test has been reported negative.

Urinalysis: Alkaline; specific gravity 1.018; no sugar; albumin, trace; 30 to 40 leucocytes per field.

Blood Wassermann: Negative.

Blood urea nitrogen, 19.6; creatinin, 1.3.

Tentative diagnosis: Mitral incompetence; chronic glomerular nephritis; arterio sclerosis; auricular fibrillation; incipient general paresis.

December 17, 1921: Condition is improved; mentality clearer; says that he has had both soft and hard chancres.

December 31, 1921: General condition has been growing weaker; irrational most of the time.

January 7, 1922: Patient extremely weak; is very noisy, demented, talkative and disturbing. Heart sounds heard with difficulty and are quite irregular. The chest also shows numerous moist râles; patient is breathing with great labor.

January 8, 1922: Patient died 11:20 a.m.

Diagnosis: Chronic endocarditis (mitral regurgitation); auricular fibrillation; chronic nephritis; arteriosclerosis.

Autopsy notes. Gross anatomical diagnoses. Heart: Cardiac hypertrophy. Lungs: Right apex scarred and retracted by chronic (healed) tuberculosis; bronchopneumonia. Kidneys: Red granular kidneys, arterio-sclerotic in type. Stomach: Chronic hypertrophic gastritis. Gall bladder: Chronic interstitial cholecystitis. Liver: Chronic atrophic cirrhosis.

Detailed description of kidneys:

"Left kidney: Weighs 85 grams measures 9 by 4 by 2.3 cm. The organ is small and firm; cuts with increased resistance. Capsule strips with great difficulty leaving a rough, granular surface, showing numerous retention cysts. Cut surface is dark red and granular. Kidney arteriosclerotic in type. Vessels stand out as pipe stems. Cortex averages 0.7, medulla 0.2 cm.

Right kidney: Weighs 140 grams, measures 11 by 6 by 3 cm. The organ is firm, cuts with greatly increased resistance; it has same appearance as fellow though not as markedly contracted."

Histological diagnoses. Arteriosclerotic nephritis. Lungs: Emphysema; bronchopneumonia. Liver: Cloudy swelling; chronic passive congestion. Brain and cord: Cerebral arteriosclerosis; hydrocephalus.

Bacteriological notes. Cultures of heart's fluid: Bacillus subtilis (contamination). Cultures from bladder lesions: bacillus coli communis.

Description of specimen.

The prostate is normal in size and there is definite sclerotic contracture of the vesical orifice. The bladder is of normal capacity with markedly hypertrophied walls and heavy trabeculation. The mucous membrane shows no acute inflammation. Scattered

FIG. 3. CASE II. MICROPHOTOGRAPH SHOWING LOCALIZED SUPERFICIAL NECROSIS OF BLADDER MUCOSA, MARKED INJECTION OF SUBMUCOSA AND SMALL AMOUNT OF INFILTRATION OF INFLAMMATORY CELLS. (×69)

at random over the bladder wall are isolated lesions varying in size from small papules measuring 0.5 by 0.5 cm. up to 2 by 2 cm. Their most characteristic feature is their laminated rupial like formation. There is no surrounding inflammation and the lesions themselves appear to be formed of necrotic tissue, whose edges can be lifted and appear to involve the bladder wall very superficially. Bacteriological cultures gave Bacillus coli communis.

FIG. 4. CASE II

No. 6469 B. Aged sixty-four. Clinical diagnosis: Chronic endocarditis, chronic nephritis. Anatomical diagnosis: Cardiac hypertrophy, broncho-pneumonia, arteriosclerosis, nephritis.

Specimen: Showing peculiar moist rupia of bladder wall, isolated, necrotic, laminated. Wassermann negative cultures show B. coli.

Microscopic pathology. (Dr. W. P. Belk.) All sections show small circumscribed, elevated areas of necrosis, involving the entire thickness of the mucosa. Immediately beneath these necrotic areas there is a moderate infiltration of large endothelial cells with practically no polynuclear cells. The submucosa shows a number of greatly dilated blood vessels. No bacteria are shown either by Giemsa's or Gram's stain, except a few Gram positive cocci in the more superficial parts of the necrotic material. Stains for tubercle bacilli are negative. No ova are present. The lesion is a chronic inflammation with superficial necrosis. There is nothing by which the true etiology may be determined.

Comment. The salient facts in the history and post-mortem of this case are as follows: (1) male, (2) age sixty-four years, (3) cardiac lesion, (4) marked arterio-sclerosis, (5) negative blood and spinal Wassermanns, (6) incontinence, (7) pneumonic death, (8) advanced nephritis, (9) cultures of lesion gives Bacilli coli communis.

The lesions themselves are remarkably superficial and simulate in their laminated appearance rupia of the skin. There are some that seem more recent in their development and appear more like a broad papule. In some regards the similarity to Bilharzia lesions may be noted, though with negative history and histology, this diagnosis cannot be sustained. A descriptive diagnosis will be given of vesical rupia of unknown origin.

As a second case of this type of bladder lesion was observed shortly after the finding of the first, I will incorporate our study of it also. These are the only two such specimens seen in examining over 1200 autopsies.

Case III. J. S., serial number C 6447, aged forty-one years, white, laborer. Born in Philadelphia. Entered Philadelphia General Hospital December 4, 1921. Died December 26, 1921.

Complaint. Cough and general weakness.

Family history. Unimportant.

Past history. Had pneumonia in 1919, following influenza, complicated with pleurisy.

Present illness. Patient was admitted to the men's tuberculosis department. (N.B.: History present is relative particularly to lung

condition.) His complaint started in 1919 following the above mentioned attack of pleurisy and influenza. The patient has lost 60 pounds in weight; has a cough, associated with expectoration; night sweats; dyspnoea; pain in the chest; hoarseness; anemia; emaciation.

Physical examination. Head: There is a loss of hair; face is cyanotic; right pupil slightly irregular, sclera anemia; teeth; poor, marked pyorrhea. Chest: Shows retracted and flattened outline decrease in expansion, marked tactile fremitus over entire right chest and upper left. There are subcrepitant râles with harsh breath sounds over both chests; expiration prolonged. Heart: Normal in outline and action. Abdomen: Tenderness over the lower bladder region but nothing palpable; pain over right and left. External genitalia: Normal in development but patient is incontinent of urine. Extremities cyanotic; fingers clubbed; reflexes present.

Urinalysis: Alkaline; specific gravity 1.026; sugar negative; albumin positive. Microscopically: leucocytes; few red blood cells, triple phosphates.

Wassermann test: Negative on all antigens.

Blood urea nitrogen 33 mgm.

Sputum: Positive for tuberculosis bacillus.

Diagnoses. Pulmonary tuberculosis; nephritis.

Patient remained on ward rapidly losing weight and strength; suffering from violent coughing attacks with occasional hemoptysis.

December 10, 1921: Patient developed subconjunctival hemorrhage of left eye ball. Tongue is a dark blue color, there are many dark pigmented areas of dull brownish black color. The addition of Addison's disease is made to his diagnoses.

December 14, 1921: Subconjunctival hemorrhage of both eyes; at times patient doses off in a semi-stupor, though he is easily aroused and talks rationally. Blood pressure: Systolic 84, diastolic 60.

December 26, 1921: Patient grew progressively weaker and died on this date, without any change in his symptomatology.

Autopsy notes. Gross anatomical diagnoses. Heart: Cloudy swelling of heart muscle; acute serofibrinous pericarditis. Aorta: Atheroma. Lungs: Chronic adhesive pleuritis bilaterally; caseous and ulcerative pulmonary tuberculosis; terminal basal pneumonia of left lung. Kidneys: Chronic diffuse nephritis. Stomach: Chronic gastritis. Bladder: Chronic papillomatous cystitis with acute catarrhal cystitis. Adrenals: Caseous tuberculosis of medulla, passive congestion.

Detailed description of genito-urinary tract as follows: "Kidneys: Both adrenals show evidence of medullary tuberculosis. Left kidney weighs 175 grams. The organ is large and fairly firm in consistency: capsule strips rather readily; surface is finely granular. Cut surface is pale pink; cortex is broadened; cortical markings are irregular but prominent. Pelvic fat is about normal in amount. Right kidney weighs 155 grams. The organ is similar to its fellow. Ureters are single and patulous."

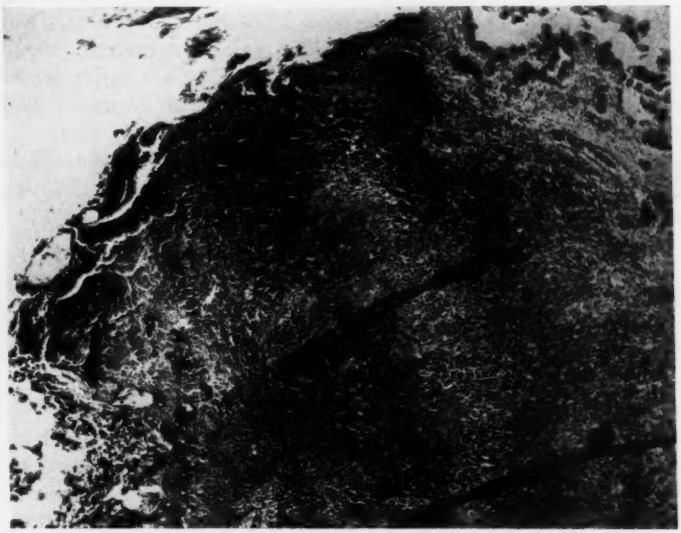


FIG. 5. CASE III. MICROPHOTOGRAPH SHOWING LOCALIZED NECROSIS OF BLADDER MUCOSA, AND INJECTION AND INFILTRATION OF INFLAMMATORY CELLS IN SUBMUCOSA. (× 69)

Histological diagnoses. Heart: Myocarditis, chronic interstitial, cloudy swelling; epicarditis, acute fibrinous. Liver: Chronic passive congestion; cloudy swelling. Kidney: Nephritis, chronic interstitial; cloudy swelling. Adrenals: Senile type; no tuberculosis; adrenalitis; chronic interstitial.

Description of specimen. The bladder is small and thick walled. The inner surface presents a striking appearance and scattered

over the lower half of the postero-lateral bladder wall are numerous large greyish yellow chalky papillomatous excrescences, probably ten in number, and situated on a mucosa that is markedly injected but not ulcerative. Each separate excrescence is raised and built up of lamina exactly similar to the rupial lesions of the skin, though of course of soft consistency.

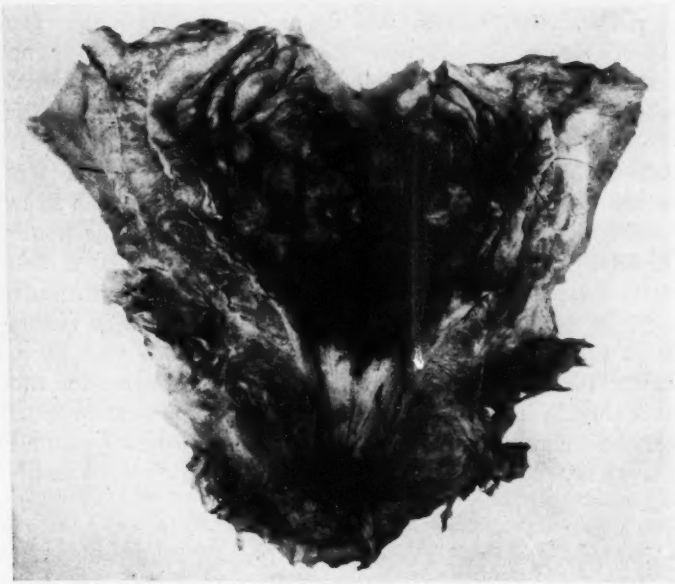


FIG. 6. CASE III

No. 6447 B. Museum. Aged forty-one. Clinical diagnosis: Chronic pulmonary tuberculosis, Addison's disease. Anatomical diagnosis: Myocarditis, pulmonary tuberculosis, chronic interstitial nephritis and adrenalitis. Heart blood cultures sterile.

Specimen: Of peculiar moist rupia of bladder wall; isolated, necrotic, and laminated.

Microscopic pathology. (Dr. Wm. P. Belk.) This case is in all respects the same histologically as case II except that there is more marked cellular infiltration underlying the necrotic areas with large

endothelial cells and an equal number of polynuclear leucocytes. About 50 per cent of the latter are eosinophiles with a few small lymphocytes. Again there are no bacteria shown with either Giemsa's or Gram's stain. Stains for tubercle bacilli are negative. No ova could be found, and there is no evidence of neoplastic proliferation. There is nothing by which the true etiology may be determined.

Comment. The outstanding features of this patient's history and post-mortem examination are as follows: (1) male, (2) age forty-one years, (3) advance pulmonary tuberculosis, (4) incontinence, (5) negative blood and spinal Wassermann, (6) Addison's disease, (7) pulmonic death, tuberculous; (8) chronic nephritis.

These two specimens represent the only examples of such vesical lesions seen in over 1200 personally inspected bladders at autopsy. This patient's family was interrogated and likewise affirmed that he had never travelled far from his home in Philadelphia. The only point of similarity, (and that a distant one) to case II was the presence of pulmonary tuberculosis, though in case II this was the healed apical lesion so generally seen at autopsy and devoid of any apparent activity. Sections from the bladder lesions in both cases were negative for tuberculosis though intensively sought. This specimen showed more apparent inflammation, though no organisms could be found in the sections. A diagnosis of vesical rupia, or rupial cystitis is given.

DISCUSSION

Dr. Bransford Lewis (St. Louis): Dr. Rathbun's expedient for getting at the segregated urines in case of tuberculous renal infection is ingenious, and theoretically plausible. I do not believe, however, that it should be accepted without considerable reluctance—for several reasons. In the first place, I think a difficult cystoscopy and painful ureterial catheterization depends upon too many different things—the skill and experience of the operator, efficiency of anesthesia, completeness of preparations, etc., before attempting cystoscopy. I remember one case in particular where the cystoscopist tried to catheterize a tuberculous case and I was informed that two or three different attempts were made under general anesthesia for an hour and fifty minutes, without success, and yet we catheterized the same case easily under local anesthesia within ten minutes. I have always contended that ease or difficulty in catheterization depends on placing the bladder at full rest before making the attempt, doing away with resistance in the bladder, and getting a good relaxation. I would not be in favor of accepting any statement of inability to catheterize the ureters unless the attempt had been made under favorable conditions and by a well versed operator.

I think the suprapubic operation would not materially benefit the case, because the trouble comes from above; and I doubt if I would want a suprapubic incision in a case where I had to do a nephrectomy later on.

Dr. William A. Frontz (Baltimore): This type of case does offer considerable difficulty in diagnosis. It has been our custom in cases where it is impossible to catheterize either side to first get the total function, endeavoring to establish the uniform character of the function. If the total is normal, we conclude we are dealing with unilateral tuberculosis, if we have first demonstrated the tubercle bacilli in the urine.

I think indigo-carmine will enable one to establish a very definite diagnosis in cases of this type. It has been our custom to inject 8 to 10 cc. and wait fifteen or twenty minutes, then use the cystoscope either with general or local anesthesia, and watch the ureteral orifice for function I recall 2 cases, both young individuals, in which this was the only way in which a diagnosis could be established. In those cases the indigo-carmine appeared very densely from the normal side, whereas none of the dye appeared on the side which was subsequently proven by operation to be involved. I think this method is more or less generally known and employed, and I think it should be certainly used where catheterization fails before any such procedure as Dr. Rathbun mentions is carried out.

Dr. WILLIAM F. BRAASCH (Rochester): I think Dr. Rathbun is to be commended for calling our attention to the fact that cystoscopy of a tuberculous bladder is occasionally accompanied with great danger. We have a record of 4 deaths following cystoscopy made in tuberculous bladders. These 4 deaths occurred where the usual clinical care was used to guard against accident. In 1 case an extensive stricture of the urethra was ruptured, and in 2 other cases a contracted bladder was penetrated by the cystoscope. The fourth case I was unable to ascertain the exact cause of death. We must be very careful in the introduction of the cystoscope, in order not to introduce it too far. With a small contracted bladder it is frequently impossible to introduce the usual length of cystoscope.

Whenever it is impossible to obtain sufficient cystoscopic data to warrant operation, because of anatomic deformity, we have no hesitancy in making a bilateral renal exposure. Where the bladder condition has progressed to such an extent that cystoscopy is not possible, there is usually a well advanced lesion of the kidney which can be readily recognized on surgical exposure. Frequently the clinical data are such that it is necessary to explore but one kidney. We have resorted to this method on a number of occasions without experiencing any complications. In my opinion this would be preferable to having a persistent urinary

fistula, which the method that Dr. Rathbun has suggested would necessitate.

Dr. GEORGE GILBERT SMITH (Boston): I would like to ask Dr. Braasch how one can tell whether there is an early lesion of the pelvis or the pyramids. If there were an early tuberculosis on one side and advanced on the other, would you feel it wise to go ahead and take out the worst kidney. I wish he would say a word about his position in that matter.

Dr. W. F. BRAASCH: Answering Dr. Smith, if the kidneys were found to be equally diseased, it would be better to leave them alone. Usually, however, the disease is far advanced in one kidney and the other is only slightly or not at all diseased, and the surgical indications are evident in the hands of the experienced operator.

Dr. HENRY H. MORTON (Brooklyn): Once in a while we cannot find the ureteral orifice, even with the aid of anesthesia, and I for one am very much obliged to Dr. Rathbun for suggesting this simple surgical operation which will enable us to make an accurate diagnosis of the condition. In both cases he was able to diagnose unilateral tuberculosis, remove the kidney, and the patient was benefited.

Dr. RICHARD F. O'NEIL (Boston): In cases where we have been unable to catheterize the ureters we have employed surgical exposure and palpation of the lower end of the ureters instead of the palpation and inspection of the kidney.

I would like to ask Dr. Randall a question. Some years ago I reported some cases of gangrene of the bladder, and I wondered if his first case could have been a beginning necrosis of the mucous membrane. This is generally due to circulatory changes plus infection.

Dr. JAMES PEDERSEN (New York City): In Dr. Randall's presentation, the first case seems to me to be one of syphilis of the

bladder. We know that vesical syphilis occurs in three forms: (1) scattered, reddish blotches, comparable to the macular eruption on the skin; (2) a diffuse hyperemia; (3) a true growth or hyperplasia which cannot be differentiated cystoscopically from a malignant growth. This may be a case of the second form; but the extraordinary thing is the absence of greater ulceration. The marked hyperemia having been present for some weeks, at least, would lead one to expect more ulceration.

Dr. NATHANIEL P. RATHBUN (closing): I think Dr. Lewis' attitude is a fair one. I did not wish to imply that cystotomy should be indiscriminately used where the ureters can be catheterized. However, I do believe there are some cases in which it is impossible to catheterize the ureters. My two cases were subjected to four cystoscopies by three or four different men before I undertook the cystotomy.

Indigo-carmine did not help my case, because the granulations bled so freely that it obscured the field.

Where it is impossible to catheterize the ureters I think suprapubic cystotomy is the method of choice. Suppose you cut down one side and find there is renal tuberculosis, you cannot be sure there is no tuberculosis, on the other side. Then there is the other point, which I think has no valid objection to it, and that is that you put the bladder absolutely at rest and give the patient a better chance to get in shape; and second, you have an opportunity to treat the bladder and I believe shorten the convalescence.

Dr. ALEXANDER RANDALL (closing): Dr. O'Neill suggests the first to be a case of gangrene. I have been particularly interested in gangrene, due to some of the work the medical men have been doing in the University of Pennsylvania. I have seen dozens of these cases at autopsy showing gangrene in all its phases, antemortem and post-mortem, but this case is a different picture. My final diagnosis agreed with Dr. Pedersen—that it is an acute hemorrhagic cystitis, probably luetic in origin.

In regard to the second case, it was particularly interesting because we have at present a man in the hospital who presents in the living practically the same lesions. My associate, Dr. Pelouze, when cystoscoping him startled the whole clinic by turning to the patient and asking him how long he had lived in Egypt. The man replied he was there four years. "Did you have some bladder trouble at that time?" "Oh, yes, I had the usual thing that everybody in the Army had." We have been trying to prove that man to have bilharziasis, but so far have been unable to do so. It is interesting because connection with some antimony work I have been doing this drug is recommended for bilharziasis. A few weeks ago I gave this man his first injection, and he had a complete return of this old symptoms and for a few days ran one of his typical attacks. A second injection brought about another recurrence of symptoms, and though we are still at a loss to find the ova for an absolute diagnosis, we are more or less sure that we are dealing with bilharziasis of the bladder, and the picture is almost identical with the second specimen shown you.

RETENTION OF URINE DUE TO CONGENITAL HYPERTROPHY OF THE VERUMONTANUM

HENRY G. BUGBEE

New York

On December 15, 1922, the following case was seen in consultation at the Babies Hospital. The child, G. S., was a male three and one-half years old. He had been sent into the hospital for polyuria and a urethral discharge which had been present since contracting a cold in December, 1921. He was a well-developed, well-nourished child. On admission the abdomen was distended. Palpation showed the bladder reaching to the embilicus, no tenderness or rigidity; kidneys, liver, spleen not felt. Other physical findings were negative. The urine was cloudy, 1007, alkaline, showed a trace of albumin, acetone and sediment of triple phosphates; blood urea 37.5; uric acid 4.61; X-rays were negative. The diagnosis on admission was urethral obstruction and secondary hydronephrosis. Cystoscopic examination December 15, 1922, the bladder was palpated at the level of the umbilicus. Under general anesthesia a small cystoureteroscope was passed which encountered a slight obstruction at the vesical neck. The bladder was atonic, showed slight trabeculation, no diverticula, no congestion. Each ureteral orifice was dilated to 1.5 cm. in diameter and clear urine containing flakes was discharged from each side.

The vesical orifice was dilated and the posterior urethra which was also of large caliber was easily examined as far as the verumontanum. The verumontanum was enormously enlarged, forming a ball valve obstruction of the prostatic urethra. There were no folds of mucous membrane above or below the verumontanum giving valve-like obstruction, but a definite blocking from the verumontanum itself. There were no folds or valves

distal to the verumontanum. This patient left the hospital at Christmas time and has not as yet returned.

While the urological picture was clear cut I was doubtful of the correctness of my interpretation until talking the case over with Dr. Martha Wollstein, pathologist to the Babies Hospital, who assured me that a definite, rounded hypertrophy of the

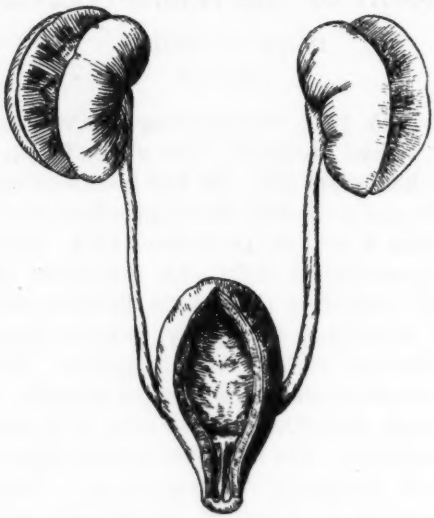


FIG. 1. NORMAL VERUMONTANUM, BLADDER, URETERS AND KIDNEYS

Microscopic examination of the normal verumontanum showed that it was made of the urethral mucosa composed of connective tissue with few elastic fibres. The arrangement was not a dense one. Glands and a few small vessels were present. The covering epithelium, consisting of several layers was intact. Behind the verumontanum was a cross section of the middle lobe of the prostate gland carrying the prostatic utricle and the ejaculatory ducts.

verumontanum itself entirely free from folds or valve formations of the mucous membrane could cause such an obstruction and that at the Babies Hospital were postmortem specimens to corroborate the correctness of such a lesion.

A review of the autopsy records of the Babies Hospital followed and revealed 6 cases of double pyonephrosis with dilatation of

both ureters and 2 cases of double hydronephrosis with dilatation of both ureters. Seven of these 8 cases presented a definitely enlarged verumontanum which caused an obstruction in the prostatic urethra, the urethra being free from all valve formation or congenital malformation. The eighth case presented a valve-like fold of mucosa at the neck of the bladder to the vesical side of the verumontanum.

There were 5 cases of single hydronephrosis, 3 due to a valve-like fold of mucosa at the opening of one ureter, 1 due to atresia of one ureter and 1 due to double ureter with constriction near the kidney pelvis.

The ages of these children varied from three weeks to three and one-half years; all but 2 were under one year.

As complete autopsy specimens of 4 of the 7 cases presenting retention due to hypertrophy of the verumontanum were well preserved a drawing was made of them, also of a normal urinary tract for comparison. The case histories and autopsy findings of these 4 cases are as follows:

Case 1

W. N., history No. 6299, a boy thirteen months of age, admitted February 16, 1905. The chief complaint was colic and vomiting which had persisted for three days with a moderate fever, prostration, abdominal pain and constipation. The physical examination showed heart and lungs normal. The abdomen revealed tumors present in the left kidney region and right lower quadrant. The tumor in the left kidney region was tender and increased in size under observation. A catheter was passed easily, the bladder containing several ounces of residual urine which was cloudy, alkaline, contained a trace of albumin, few casts, many pus and epithelial cells and numerous micrococci; leucocytes 23,000.

The patient failed steadily and died on the tenth day after admission.

The autopsy record no. 508, by Dr. Wollstein, is as follows:

Anatomical diagnosis. (1) Double hydronephrosis and hydro-ureter. (2) Bladder hypertrophy. (3) Enlarged verumontanum. (4) Splenic hyperplasia. (5) Hyperplasia of lymph nodes.

Heart. Normal. Foramen oval closed.

Lungs. No pleurisy. No pneumonia. Both lungs were well aerated.

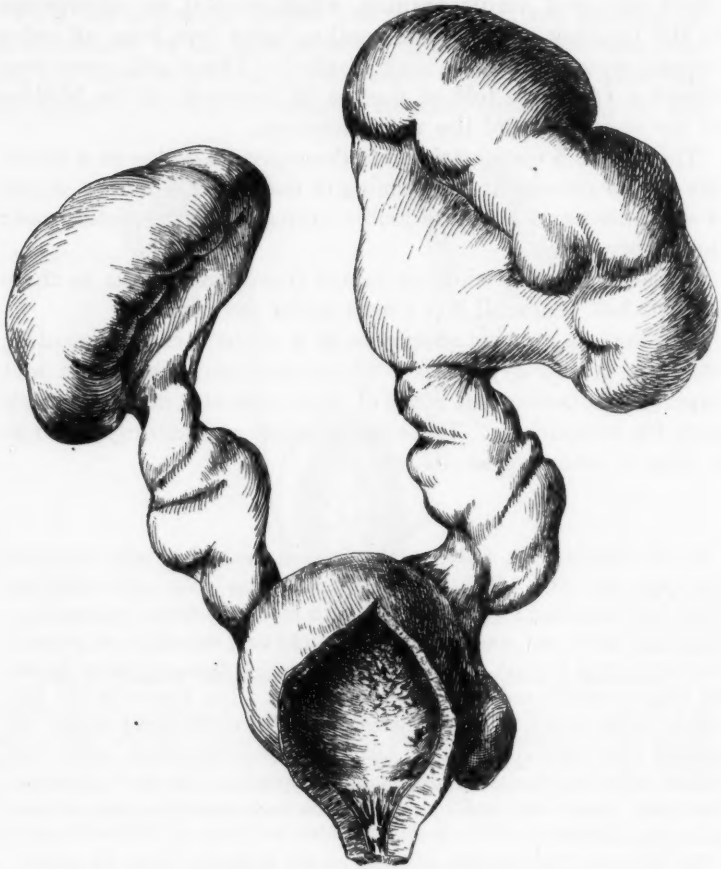


FIG. 2. HYPERTROPHY OF VERUMONTANUM. HYPERTROPHY OF BLADDER, DILATATION OF URETERS, KIDNEY PELVES AND CALYCES. (CASE 1.)

Bronchial lymph nodes. Normal.
Spleen. Ten centimeters long. Hard and firm.
Liver. Normal size. Congested. Not cirrhotic.

Stomach. Small. Mucosa normal. Empty.

Intestines. Normal throughout.

Mesentric and retroperitoneal lymph nodes. Slightly enlarged and red. None cheesy.

Kidneys. Left: 10 cm. long, lobulated, each lobule appearing like a cyst; the pelvis was funnel shaped 5 cm. high and 9 cm. at base, it being largest on the anterior surface of the kidney. *Its ureter was 7 cm. in circumference at the bladder.* The ureter had 4 curves in its course, and throughout was larger than the colon. *Right:* 12 cm. long, less cystic and more solid than the left. Pelvis more apparent on posterior surface and measured 6 cm. long and 3 cm. high. Its ureter had 5 curves and was slightly smaller than the left. On opening the kidneys, the left one was found to be converted into a bag of fluid, the walls of which were made by compressed kidney substance 2 to 4 cm. in thickness. All the calyces were markedly dilated and the pelvis was funnel-shaped, 9 cm. wide and tapered into the ureter. The right kidney showed less compression of the substance, which measured 6 to 10 cm. in thickness. The dilatation of the pelvis was less marked than on the right side.

Bladder. Measured 8 by 6 cm. and 14.5 cm. in circumference. The wall was 1 cm. thick. The mucosa was pale and there was no obstruction at the ureteral or urethral orifices. The neck of the bladder measured 2.5 cm. in diameter. The verunmontanum was enlarged to 0.5 cm. at its thickest point. No valve-formation or folds of mucous membrane were found at vesical neck or in urethra.

Microscopic examination of verumontanum showed that it was composed of a fold of mucosa covered with stratified epithelium, the superficial layers of which were pealing. There were connective tissue and elastic fibers in the fold, more densely arranged than in the adjacent urethral mucosa. Glands were present. Behind the fold of the verumontanum was a cross section of the middle lobe of the prostate gland, with the prostatic utricle in its center and the ejaculatory ducts at either side. The lateral lobes of the prostrate were normal.

Case 2

L. B., history No. 22283, a male child five weeks old admitted February 15, 1923. The chief complaints were swelling the abdomen of two days duration and jaundice since birth. Examination showed a feeble month old baby, markedly jaundiced, blood count normal; heart and

lungs were normal; abdomen showed liver and spleen enlarged, and a large, smooth, firm, round mass, somewhat movable in the right lower quadrant, a smaller, similar tumor occupying the left lower quadrant. A pyramidal mass occupied the suprapubic region ascending to the umbilicus which was markedly pouting and blue. This latter mass proved to be a distended bladder. The child died at the end of twenty-four hours.

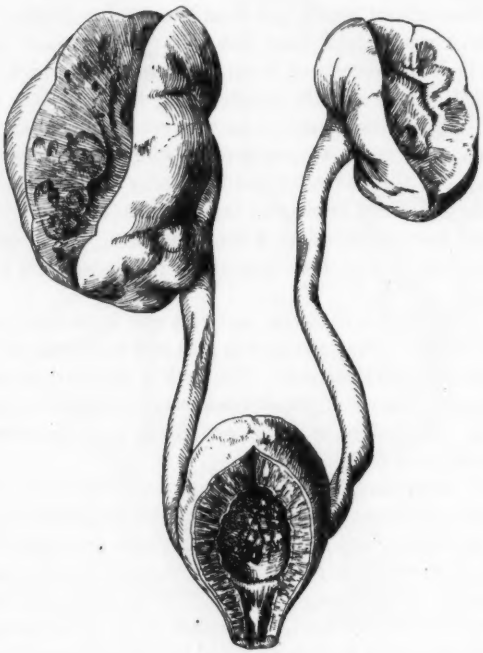


FIG. 3. SAME AS FIG. 2. (CASE 2.)

The autopsy record No. 4678, by Dr. Wollstein is as follows:

Anatomical diagnosis. (1) General icterus. (2) Bronchopneumonia. (3) Purulent lepto-meningitis (streptococcus, non hemolyzing). (4) Double pyonephrosis: dilatation of ureters. (5) Cystitis and hypertrophy of bladder wall. (6) Enlarged verumontanum. (7) Otitis media purulenta. (8) Abscess of allantois.

The body was that of a well nourished, male, white infant, with marked icterus and distended abdomen. The umbilicus was dry and healed.

Brain. Dura mater normal. The sinuses contained fluid blood. The pia arachnoid was cloudy over the entire brain. At the base there was a purulent exudate, especially marked over the surface of the pons and medulla and under surface of the cerebellar veriform. The exudate extended up on to the outer surface of the cerebral hemispheres, but in small quantity only, along a few sulci. The ventricles were not dilated. The upper segment of the spinal cord did not show any exudate, but its pia was cloudy.

Middle ears. The right was normal; the left contained greenish pus in small amount.

Heart. Bile stained. The valves and the septa were normal. Muscle flabby. Ductus arteriosus and foramen ovale closed.

Lungs. No pleurisy. Anteriorly both were well aerated. Posteriorly there was a consolidated area in the apex of the right lower lobe, 2 by 3 cm. in diameter. This was acute bronchopneumonia, red and firm. In the left lower lobe a smaller and softer area marked an earlier stage of bronchopneumonia. The upper lobes were both free.

Larynx, trachea and bronchi. Moist, icteric.

Bronchial nodes. Not enlarged.

Spleen. Measured 8 by 4 cm. Soft, friable, red, capsule, wrinkled.

Liver. The liver extended 2 cm. below the ribs in the mamillary line. It was soft and showed parenchymatous degeneration.

Peritoneum. Normal.

Umbilicus. Healed externally. Its posterior surface was smooth. The vein (round ligament of liver) was not pervious. The arteries contained soft clots, but were not pervious. Between the umbilicus and the bladder, attached to the upper border of the bladder, was a swelling 2 by 2 cm. which was an abscess containing thin, yellow pus. It did not communicate with the bladder nor with the peritoneal cavity, nor with the umbilicus.

Stomach. The mucosa was normal. It contained blood stained mucus and blood.

Intestines. Many capillary hemorrhages into the mucosa throughout the small gut. There were no ulcers. The colon was slightly congested.

Mesenteric nodes. Not enlarged.

Pancreas. Normal.

Suprarenals. Normal.

Kidneys. The *right* measured 8 by 4 cm. and extended below the pelvic brim. Its surface was nodular. The *left* kidney was smaller and in its normal position, measuring 6 by 3.5 cm. in diameter. Both ureters were dilated and tortuous, 1 cm. wide. On section the right kidney showed a much dilated pelvic filled with yellow pus. The entire substance was riddled with abscesses, 2 mm. to 1 cm. in diameter. One calyx was much dilated. Several small hemorrhages were present

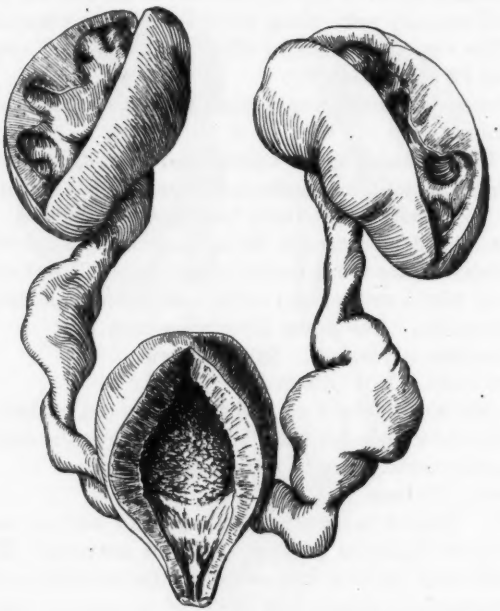


FIG. 4. SAME AS FIG. 2. (CASE 3.)

where an abscess had eroded a vessel in the cortex. The left kidney showed a greatly dilated pelvis and calyces, with a much thickened lining. The kidney substance was compressed but showed no abscesses.

Bladder. Measured 5 cm. long by 4 cm. wide. It contained 2 cm. of turbid urine. Its walls were greatly hypertrophied, measuring 0.5 to 1 cm. in thickness. The mucosa was congested, wrinkled and showed many submucous hemorrhages. There was a small fold of mucosa just above the trigone but apparently not interfering with the flow of urine.

The neck was dilated. The ureteral openings were large and readily admitted a probe. The urethra contained a very large verumontanum. No valve formation or folds of mucous membrane at vesical neck or in urethra were present.

Bacteriology. Heart's blood: streptococcus, non-hemolyzing. Right kidney: streptococcus, non-hemolyzing and B. coli communis. Meningeal pus: streptococcus, non-hemolyzing.

Case 3

A. H., history No. 4331, a male child thirteen days old, admitted October 25, 1910. The chief complaint was swelling of the abdomen and inability to urinate. The child had passed blood in the urine when three days old which had continued for three days. Urination was in drops. Appetite good, bowels regular, vomited the day of admission. As the child was moribund on admission a complete physical examination was not made. He was cyanosed, chest free, abdomen distended. There was a large, hard, smooth tumor in each iliac region and a third in the median line above the symphysis. Temperature 98, pulse 148, respiration 56. A catheter passed reducing the suprapubic mass. The urine was alkaline, heavy trace of albumin, many pus and epithelial cells, few casts and many colon bacilli. He died ten hours after admission.

The autopsy record No. 1199, by Dr. Wollstein, is as follows:

Anatomical diagnosis. (1) Double pyonephrosis and dilatation of ureters. (2) Hypertrophy of bladder. (3) Enlarged verumontanum. (4) Acute suppurative peritonitis. (5) Pulmonary congestion and edema. (6) Acute splenic tumor.

The body was well formed and well nourished. The abdomen was distended. The umbilicus was quite dry and healed. The umbilical vessels contained no pus.

Stomach. The stomach was distended with food and blood stained mucus. The mucosa showed large superficial erosions.

Peritoneum. The peritoneum contained about 30 cc. of turbid, yellow fluid. There was a recent exudate of fibrino-pus over the intestines, spleen and liver.

Spleen. The spleen was slightly enlarged, soft and covered with the exudate.

Liver. Congested and showed a few shreds of the exudate.

Intestines. No malformation.

Pancreas. Normal.

Suprarenals. Normal.

Mesenterics. Normal.

Heart. Normal. Foramen ovale open.

Lungs. No pleurisy and no pneumonia. There was very intense congestion and edema.

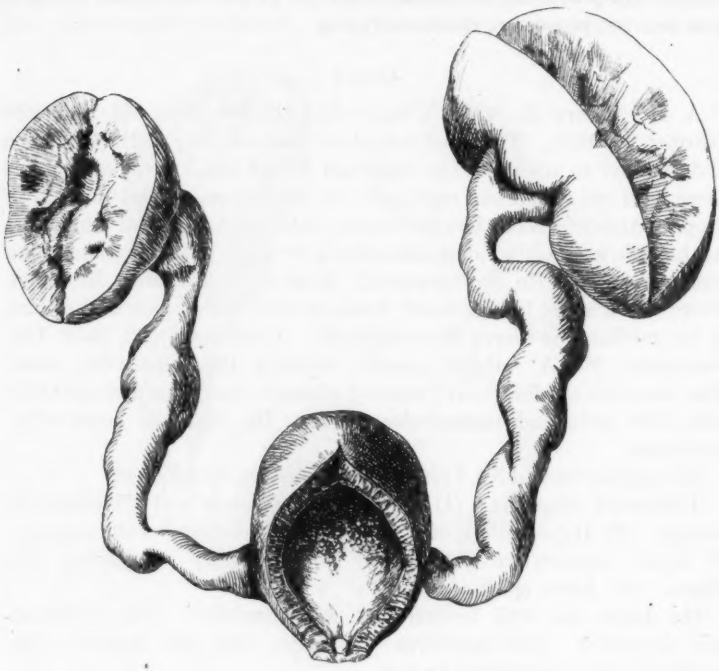


FIG. 5. SAME AS FIG. 2. (CASE 4.)

Kidneys. The *left* measured 5 cm. long and 3 cm. wide. The pelvis and calyces were dilated, compressing the kidney substance to 0.30, while at the widest portion of a Malpighian pyramid it measured 1 cm. The opening into the ureter was 2 cm. and in its tortuous course the ureter measured from 0.5 to 2 cm. in calibre. There were small perirenal hemorrhages over the kidney, outside the capsules. The Malpighian pyramids contained small abscesses. The urine was cloudy.

The *right* was 6 cm. long and 3 cm. wide. The opening of the ureter was only 1 cm. in diameter. The calyces were dilated and the kidney substance compressed as in the left kidney, but there was less hemorrhage and more diffuse suppuration present in it. The ureter was more tortuous and wider than the left. Both ureters were wide at the bladder opening, and readily admitted a small probe.

Bladder. The walls were markedly hypertrophied, measuring 0.5 to 1 cm. in thickness. The mucosa was hemorrhagic in color and showed deep folds with many dilated blood vessels. The urethral opening seemed to be dilated and the fold of the verumontanum was greatly enlarged. There were no valve formations or folds of mucous membrane in the urethra.

Case 4

J. D., history No. 18845, a male child three and one-half years old. Admitted January 2 , 1921. The chief complaint was irritability and drowsiness of three days duration. He had convulsions when eight months old and one or two since then. For the past few days has been drowsy, irritable, feverish, constipated and refuses food. Until three days ago child was bright, took food well and appeared healthy. Urination painful and urine contains blood. Child fairly well developed, poorly nourished, lies on his back with head turned to left. Was very irritable and hyperesthetic. Left kidney palpated. Child died within twenty-four hours.

The autopsy record No. 4342, by Dr. Wollstein, is as follows:

Anatomical diagnosis. (1) Enlargement of verumontanum. (2) Dilatation of both ureters. (3) Double pyonephrosis. (4) Rachitis. (5) Bronchitis.

The body was that of a well nourished, poorly developed, white boy. No craniotabes. The legs were bowed, the ribs beaded. The skin was clear.

Lungs. The lungs showed no pleurisy and no pneumonia. Both were well aerated and showed no evidence of tuberculosis. There was a marked edema present on section of the lung, and a very marked general bronchitis.

Bronchial lymph nodes. Red and not large.

Heart. Normal.

Liver. The liver was large, congested and very slightly fatty.

Spleen. The spleen was large (10 by 5 cm.) a very markedly hyperplastic and the Malpighian bodies were prominent. There were areas of congestion.

Stomach. The stomach was empty and normal.

Duodenum. Normal.

Mesenteric lymph nodes. Not enlarged.

Kidneys. The *left*, 9 by 4 cm., was about twice as large as the right. It showed a markedly dilated pelvis with moderate compression of the kidney substance. Pus was present in one of the calyces. Suppuration was present in the pyramids and was extending into the cortex.

The *right* kidney was smaller than the left and contained no pus. The pelvis and calyces were markedly dilated. The substance was compressed and the markings blurred without the presence of purulent infiltration.

Ureters. Both were much dilated and tortuous. They measured 1 to 3 cm. in caliber.

Bladder. The bladder contained blood stained urine. The wall was slightly thickened and the mucosa deeply congested. There were many small submucous hemorrhages. The entrance to the urethra was blocked by the enlarged verumontanum, which made a papillary enlargement 1 to 2 cm. in height, blocking the egress of the urine. The openings of the ureters into the bladder were larger than normal. No valve formations or folds of mucous membrane in the urethra.

Bacteriology. Pus from left kidney, B. coli communis.

In a most comprehensive paper by Hugh H. Young, William A. Frontz and John C. Baldwin presented before this Association in 1919, the writers reported obstructions more or less complete, due to the presence of abnormal valves or folds in the posterior urethra, adding 12 cases to 10 reported in the literature previous to that time in which the diagnosis was confirmed by instrumental methods, operation or autopsy. The writers made a thorough review of the literature up to that time covering the embryological study of the deep urethra and verumontanum with reference to valve-like formations of mucous membrane, two types of which were more or less connected with the verumontanum and a third entirely separate from this structure but all quite distinct from the type of obstruction in the cases here reported. With the exception of this second case which was on autopsy record only and I believe was a case similar to the ones reported in this paper, the obstruction was due to folds and valve formations, not to hypertrophy of the verumontanum.

The literature since this excellent presentation contains no reference to the type of obstruction demonstrated by the cases we are reporting.

The pathology above the point of obstruction in our cases was identical with the descriptions of the cases given by Young, Frontz and Baldwin. The condition of the vesical neck and deep urethra was the same in each of our cases here reported, i.e., the vesical neck was dilated so that the urethra to the verumontanum formed part of the bladder. The verumontanum in each case formed an obstruction exactly like that caused by a more or less pedunculated median prostatic lobe. There were no folds or valve formations present, although most careful search was made at the time of the autopsy and in the specimens now available. A complete and accurate record was kept of 3 cases which were demonstrated at autopsy but are not included with this report of 4 cases, as the specimens have been lost. Sections of the verumontanum removed in one case of obstruction showed structure identical with the normal verumontanum, plus hypertrophy. The verumontanum presented the same gross appearance in each of the other specimens but was not removed that the specimens might be preserved.

The ages of the patients reported were thirty months in the living; the specimens thirteen months, five weeks, thirteen days, three and one-half years. Of 3 other cases of which we have autopsy record only, all were under one year of age.

A previous clinical history in such children, especially hospital cases, not under intelligent prehospital observation and brought to the hospital in a uremic condition or suffering from some complicating disease may throw little light on the condition and while the diagnosis in many cases will only be made at autopsy, any male child with a history of difficulty of urination or incontinence should be studied carefully with the possibility of a congenital obstruction of the deep urethra in mind.

Palpation and percussion of the suprapubic region, of either upper abdomen and flank, the passing of a catheter, a cystoscopic and urethroscopic examination and cysto-uretero pyelography should if possible be carried out.

The only hope of relief is in an accurate diagnosis of the lesion, if possible, before infection has supervened. The kidney function is always poor and with the advent of infection rapidly diminishes. The relief of back pressure should be gradual if possible, for suppression is to be expected with the establishment of drainage.

A cure can only be accomplished by removal of the obstructing verumontanum, best by fulguration or cautery either through a cysto-ureteroscope, suprapubically, or by open perineal operation as described by Young as one method of removing valve formations. The result will be determined largely by the amount of functioning kidney tissue remaining and the completeness of the removal of the obstruction. By impressing upon the pediatrist the frequency and importance of congenital anomalies of the urinary tract it may be possible to discover such obstruction lesions, more often in the living and to apply early treatment.

REFERENCE

YOUNG, H. H., FRONTZ, W. A., AND BALDWIN, J. C.: Jour. Urol., October, 1919, v.

DISCUSSION

Dr. HUGH H. YOUNG (Baltimore): We are greatly indebted to Dr. Bugbee for bringing up what seems to be something entirely new in genito-urinary pathology. Dr. Frontz and I went carefully through the literature a few years ago in presenting the subject of valves of the posterior urethra, but we found nothing that would correspond to this at all, and I therefore think Dr. Bugbee has discovered something that is quite new.

The whole subject is one of great interest, and one that has been neglected entirely by the pediatrists, who are the people who really see these early cases.

A number of years ago, I had a case on which suprapubic drainage had to be done. It was impossible to pass the instrument into the bladder, and when I opened the bladder suprapubically I was amazed to find the internal orifice widely dilated, and with my finger I found an obstruction 1 cm. down near the verumontanum, a diaphragm between my finger and the sound in the urethra. I divided this diaphragm and cured him in that way. After that we had eleven other cases, some of them very interesting, where owing to the emaciation the greatly distended ureters could be seen through the musculature of the abdomen. The kidneys in those cases were very large and usually palpable. In practically all of them there was great impairment of renal function, but in 10 consecutive cases it was possible to operate, either through the bladder or the urethra, and to remove the valvular obstruction and finally cure them.

The literature showed 14 cases, but only 1 child was saved; in the other cases the condition was discovered at autopsy. In an article by Osler on "Paralysis of the bladder in children," he said it was not infrequently seen and with no apparent cause. I think those cases were rather valves of the posterior urethra, or what Dr. Bugbee has described, hypertrophy of the verumontanum.

Englisch of Vienna has described a series of conditions, particularly cysts of the verumontanum and other aberrant structures, and I would like to ask Dr. Bugbee if by any chance any of these were cystic conditions in the verumontanum. I think the whole subject is worthy of a great deal of attention on the part of this body, and I hope we will take back to the pediatrists the fact that they should be on the lookout for these cases, and whenever a case presents of chronic uremia in children, or of incontinence that cannot be explained, these cases should be studied carefully by a urologist.

Dr. Bransford Lewis (St. Louis): I wish to add my compliments to Dr. Bugbee on his presentation. I have never seen a case in which the pathology was due to hypertrophy of the verumontanum, but I have seen 3 interesting cases which impressed on my mind the necessity. as Dr. Young has said, of bringing this back to the general practitioner and the pediatrist. I would include the general practitioner.

One of my cases was a little boy who had a most torturing condition of increasingly difficult urination that had lasted for many months, so that for two or three months before he was brought to me his practitioner, who was a very intelligent man, had to use morphine, and many times had to use general anesthesia to get the catheter in. Without spending very much time in investigation, I opened the perineum, and with my finger I could feel a tight contraction at the neck. I did not feel the veru. I do not believe it was a case of hypertrophy of the verumontanum. I made two incisions, one on the left and one on the right, and opened up that contracted neck so I could easily get my finger in. He got well. I saw him three years later and he was entirely well.

I saw a little girl two years and eight months old who had a contracted urethra and obstruction. On cystoscoping we found a great big pyonephrosis holding, when removed, more than a pint of pus. We took out that kidney and dilated her urethra freely, and she got well.

The third case was one of bacteriuria, the irritant effect producing a contraction of the urethra and complete retention. She could not urinate without catheterization. This girl was twelve years old. We dilated the urethra and reclaimed her ability to urinate. Then I saw her when she was twenty-six years old. She had had a recurrent attack of bacteriuria, contraction and retention of urine, requiring uretheral dilatings and irrigations, followed by recovery.

These are three different lesions producing the same effect of retention.

The main point is to impress the general practitioner with the necessity of having these cases examined before they are dead ones. We can relieve the obstruction if we get them early enough.

Dr. A. J. CROWELL (Charlotte): The members of this Association know that I am quite a crank on ureteral anesthesia and ureteral dilatation, as well as some other things. My associates can testify to the fact that I lay great stress upon the verumontanum and symptoms produced by infections of same. An enlarged and inflammed verumontanum often produces, in the young, symptoms such as frequency, hesitancy, and diminished force with residual similar to those of hypertrophy of the prostate gland in the old, and these symptoms may be relieved by local applications to the verumontanum. Occasionally good results are obtained by fulguration or snaring the verumontanum off with Rytina's instrument.

I am sure symptoms produced by diseased conditions in the verumontanum are often misinterpreted or overlooked.

Dr. ALEXANDER RANDALL (Philadelphia): I have seen 3 cases of this type of posterior urethral obstruction, and cured 2. The first case was a boy about twelve years of age which I believe was a typical case, such as Dr. Young has described, of valve obstruction.

Cystoscoping the second case, I tried to interpret it as a valve obstruction, although I felt I was stretching a point. It was a

child eight years old, and through the cystoscope we saw a tumor mass arising from the verumontanum and thought it was a cyst. I was disappointed on not seeing it collapse when a fulgurating wire was plunged into it, and thinking it was a valve as described by Dr. Young, held open by the distended bladder fluid, I proceeded to fulgurate it, and get a permanent cure. The child since then has gone through a severe attack of scarlet fever, which is good evidence that the urinary tract above was in good condition. I think now, since hearing Dr. Bugbee, that this one was undoubtedly a case of hypertrophy of the verumontanum.

A third case is still under observation, a child seven years old with eneurisis. On cystoscopy I again interpreted it as a valve case. He has had three fulgurations and is gradually improving, and I will study him anew with this new idea in mind.

Dr. Bugbee's work is certainly a broadening one for our vision on these obscure cases.

Dr. A. R. Stevens (New York City): I am sorry I did not hear all of Dr. Bugbee's paper. Did he report that the X-ray showed absence of spina bifida occulta? I suppose that should be ruled out, but we have seen a good many patients with that condition in the children's department of Bellevue without any urinary symptoms and I have become very skeptical as to how important a factor it is in urinary trouble in children.

I have a case now under observation that was operated upon about eight weeks ago, a little boy six years of age who came in with incontinence which he had had over a long period. He had about 600 cc. of residual urine. The cystogram showed a markedly trabeculated bladder and very large, dilated ureters. Having in mind Dr. Beer's work on apparently congenital contracture of the vesicle neck which he relieved by removing a portion of that region, I did a suprapubic on this boy and found what seemed to be a tight vesicle neck. I am not sure that I know just how large a vesicle neck ought to be in so young a child, but I cut out sufficient tissue there to make the verumontanum easily palpable. It was about as large as a good-sized

pea. The boy's suprapubic wound had not closed when I left New York, and the questions are still unanswered—have I done him any good, is he a neurological case (although he had been examined very carefully by urologists who could not find anything else wrong), or will the verumontanum prove to be the real obstruction?

Dr. WILLIAM E. LOWER: Dr. Bugbee has certainly presented a very interesting group of cases. I recall a case which came under my observation a little more than a year ago—a child about nine months old with distention of the bladder and incontinence. After introducing catheters and making a cystogram, we found the ureters enormously dilated—to about the size of the small intestines. I never could determine the cause of the obstruction. The child was never in condition for a radical operation and died a few months later. I did not get a postmortem. Should another case present itself, I should certainly examine the urethra to determine whether or not the cause of the trouble could be that described by Dr. Bugbee in his case.

I think papers of this kind should be published in the journals of the pediatrician and the general practitioner as well as of the genito-urinary man, for the former are the men who see these cases first.

Dr. WILLIAM A. FRONTZ (Baltimore): As far as the question of congenital valve formation is concerned, the question of spina bifida must always be borne in mind. We have had 1 case where we thought valve formation was found, in which, following X-ray, spina bifida occulta was found to be the really fundamental cause of the obstruction. We found at operation a valve which was destroyed suprapubically, and the patient went on, but the suprapubic fistula persisted. Later X-ray showed a very definite defect which was interpreted as being a spina bifida, and which was probably the primary cause of the obstruction.

Dr. HENRY H. BUGBEE (closing): In answer to Dr. Young's question regarding a possible cystic condition of the verumontanum, in each case there was true hypertrophy of the verumontanum, but no evidence of a cystic condition. After hearing Dr. Chute's paper at Boston in 1920, I have been on the lookout for spina bifida occulta and have seen 14 cases since then. I do not think there is any possibility of this complicating the cases I have reported. In 3 of the 4 X-ray was made after death and the picture was quite different from a case of spina bifida occulta.

PAN-MURAL CYSTITIS

REPORT OF UNIQUE CASE

A. RAYMOND STEVENS

New York City

Since Hunner published his full and clear description of that type of pan-mural cystitis now associated with his name, and offered an efficient mode of treatment of these hitherto baffling cases, a number of reports of similar cases have appeared in the literature. Most of the writers have reviewed the earlier publications so that the subject has been brought frequently to the attention of the medical profession.

The case reports lead one to suspect that this condition has been diagnosed too frequently, that enthusiasm has influenced some workers to admit too readily certain puzzling cases to this new category. Distinctive features of Hunner's description are the absence of a real ulcer with gray base, and the presence of macroscopically clear urine, with only a few pus and red blood cells to be found microscopically after centrifugalization. Some writers have rather readily ignored these points. The warning has already been sounded against too hasty operation on what may be simple ulcer of the bladder; and surely one must be slow to ascribe a notable amount of pus and bacteria in the urine to a possible "Hunner ulcer." Yet the histologic picture of the bladder wall may fairly be our basis for classification, and the lesion so well described by Hunner is undoubtedly being found in cases which vary in the cystoscopic picture and urine analysis from his description. Hunner has latterly been finding pus in the urine of some of his "ulcer" patients, but is inclined to ascribe it in most instances to concurrent inflammation of other parts of the urinary tract. We must remember also that some patients may become infected by treatments received before they come under our observation.

While there is good evidence favoring the focal infection theory in explaining the etiology of many cases, the onset and development of this lesion are not understood. It has even been suggested that the infection may be paravesical in its incipiency. Very few of the reported cases have come under observation with symptoms of less than a year's duration. With one exception (here reported) those cases seen by me have had symptoms for many years and have conformed clinically, cystoscopically and in urine examinations, to the usual type. I believe the following should be classed as a "Hunner ulcer" because of the typical pathology of the tissue removed. The cystoscopic picture was atypical and there was pus in the urine. But other sources of the pus than the bladder were ruled out, and a therapeutic elimination of syphilis was made.

CASE REPORTS

A man, thirty-four years old, was first seen by me July 25, 1921. In 1905 he had had a primary syphilitic lesion and secondary eruption, followed by two years treatment with mercury. No recognized evidences of syphilis have ever reappeared. In 1913 he was given 6 salvarsane injections. Wassermann reactions taken each year subsequently were always reported negative. He had had uncomplicated gonorrhea in February 1918, and was apparently thoroughly cured. About December, 1918, he noticed a little pain on urination; relieved by argyrol instillation. Thence there was no illness nor urinary disturbance until the end of May, 1921, when pain on urination and slight frequency appeared. His doctor treated this by prostatic massage and heat applied by electric tubes placed in the rectum, with no relief to the patient. He complained in July of perineal pain during urination, of frequency (two to five times at night, and every two or three hours by day), and of varying degrees of suprapubic pain, sometimes sharp, not associated with urination. Defecation did not influence the pains, but they were worse with an attack of diarrhea. Recently he had been considerably worse following catheterization and injection of argyrol.

Examination. The patient was a robust, muscular man in apparently good health. Heart, lungs and abdomen normal. External genitalia normal. First urine slightly cloudy with a few shreds; second urine similarly cloudy with microscopically a little pus and blood but no

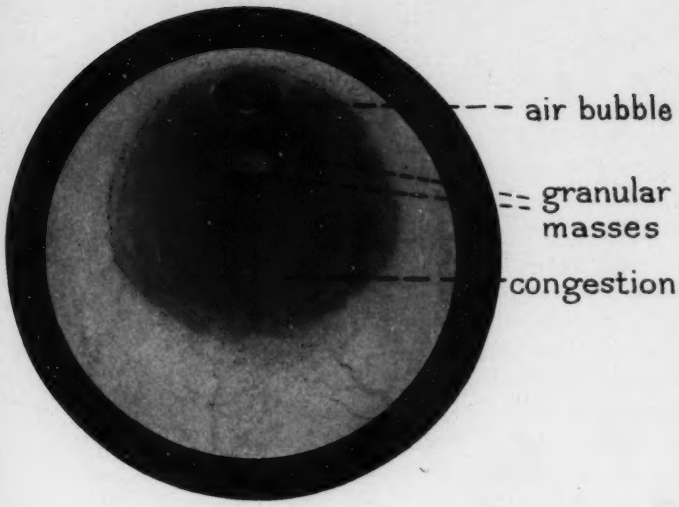


FIG. 1. CYSTOSCOPIC VIEW: VAULT OF BLADDER

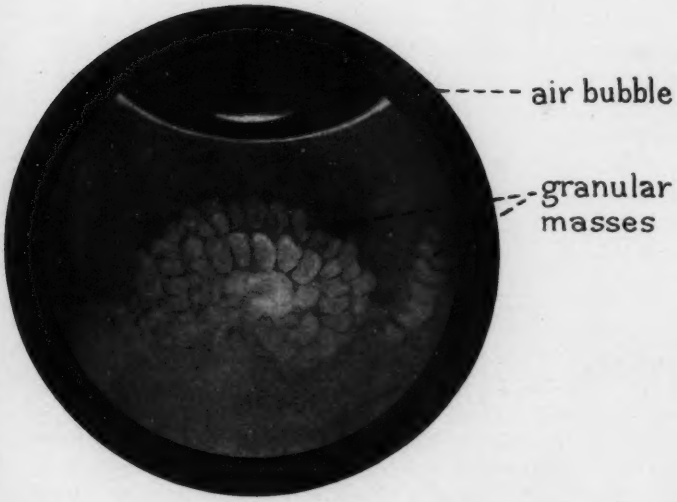


FIG. 2. CYSTOSCOPIC VIEW: CYSTOSCOPIE NEARER LESION THAN IN FIGURE 1

bacteria. Numerous examinations for tubercle bacilli the next few months were negative. Prostate and seminal vesicles felt normal and prostatic secretion contained only an occasional pus cell and no bacteria microscopically. Radiographs of the urinary tract were negative. Wassermann was positive with a cholestrin antigen but negative with an alcoholic one. Cystoscopy was painful, but the bladder would tolerate nearly 100 cc. The posterior and lateral walls, trigone and ureteral orificies were normal. But anteriorly, in mid line, above the air bubble, was a very red area, in the center of which were two small protruding masses with a mosaic surface (shown in accompanying illustration). Both ureters were easily catheterized and clear urines were obtained from both sides. These specimens contained no pus nor bacteria, and the kidneys showed about equal function as indicated by urea percentage and phthalein output.

A course of anti-leutic treatment was decided upon and instituted August 2. The Wassermann was reported as negative with both antigens on August 5 and 16. This seemed extraordinary if we were really dealing with syphilis of fifteen years duration. However treatment with salvarsan (7 injections in all) and mercury was continued for two and a half months. In the meantime, while the suprapubic pain became less marked, the other symptoms continued and generally became worse. The patient practically always got up four to five times at night, and single voidings measured day and night never exceeded 4 ounces. The pain on urination was becoming intolerable to the high-strung patient and he lost 15 pounds in weight. The urine was slightly turbid with a small amount of pus and red blood cells; rarely a few micrococci were found.

Cystoscopy was done on five occasions. The picture was essentially the same every time. No bleeding was encountered and no abnormality was noted anywhere except as above described. In September and October, the protruding masses seemed a little larger than earlier, and the area of redness increased especially on the right side, reaching near to the prostatic border.

Operation was finally advised, five months after the onset of symptoms, and was performed October 29, 1921. The bladder was exposed through a median line suprapubic incision. The peritoneum was very adherent and was dissected away from the bladder with difficulty, but was not opened. Perivesical edema was marked, particularly as the dissection proceeded towards the rectum. The deeper part of the posterior wall could not be freed from the rectum without risk of injury to the latter organ. The bladder was incised well to the left of the mid

line. The small protuberances seen by cystoscopy were scarcely recognized as shiny granular bodies. The bladder wall was found greatly thickened wherever the finger could palpate, except about half of the left lateral wall, that nearer the prostate. Nc difficulty was found during excision in keeping outside the diseased area on this side; on the right side, incision was carried through normal bladder tissue near the prostatic border; posteriorly all of the freed bladder wall was removed. At the site of this posterior incision, the bladder wall was definitely thickened but was becoming thinner as it approached the trigone. The tissue removed measured roughly 7 by 8 cm., and was 1 cm. thick in most of its extent; when it reached the laboratory it measured actually 1.5 cm. in thickness, the remaining bladder wall was sutured by two layers of catgut into a tubular cavity the length of one's finger. A rubber tube was inserted in the bladder and a cigarette drain anteriorly.

During the first few days of convalescence, the patient was very uncomfortable with bladder pain and uncontrollable attempts to urinate. The tube was left in the bladder for five days, and no urine came from the wound after the eighth day following operation. After the tube was removed, all pain ceased. Urination was frequent, but the voiding was so easy, the patient did not object. The amounts increased gradually, and had reached two ounces when the patient left the hospital three weeks after operation. In another week the amounts were four ounces, and the urine was clear microscopically with only an occasional pus cell to be found in the centrifugalized specimen. Two months after operation, voidings varied from 6 to 9 ounces, and there was no pain.

The patient was seen in March, 1923 (seventeen months after operation). He reported himself entirely well, rarely got up even once at night, and passed by measurement from 9 to 16 ounces at each urination. The urine was absolutely clear.

Pathological report. Specimen measured 1.5 cm. in thickness throughout most of its area. Sections taken from various parts of the specimen all show a loss of epithelium. Between the muscularis and the free surface there is a layer of connective tissue, which is equal to almost one half of the entire thickness of the wall. This tissue near the surface has the appearance of granulation tissue with many small blood vessels and with a focal and diffuse plasma cell and lymphocytic infiltration. The deeper portion is less cellular and more hyalinized. Areas of hemorrhage are numerous. The free surface is covered in places with a thin layer of very acidophilic, compact, acellular material resembling fibrin.

DISCUSSION

Dr. J. A. C. Colston (Baltimore): We had a case about eighteen months ago, a woman who complained of the typical symptoms—frequency and continued suprapubic pain. The urine was clear. Cystoscopically she showed a small ulcer a little over 1 cm. in diameter which we fulgurated fairly lightly, that treatment being followed by hydraulic bladder dilatation. Her frequency was reduced and whereas formerly she had been obliged to rise six or eight times at night, she has practically normal urination at present. These cases have been called pan-mural cystitis. I know the light fulguration we gave this woman could not have gone deeper than the submucosa, and the destructive action must have been limited to this layer and to the mucosa. Therefore it seems to me that the process, in its earlier stages, is limited to the mucosa and submucosa and for these earlier cases at least the term "pan-mural cystitis" is misleading.

Dr. Thomas F. Laurie (Syracuse): I would like to report a similar case in which there was a small ulcer about 2 cm. posterior to the right ureter. The appearance fulfilled all the requirements of the so-called elusive ulcer. This responded very nicely to two applications of the Oudin current and she has remained well up to date.

Dr. Richard F. O'Neil (Boston): I should like to refer to a case I reported a year ago, in which I did a bladder resection and excised what I supposed was a submucous fibroma. She did well for a certain length of time and then the symptoms recurred with severity equal to that before the operation; but the urine remained clear. She came back this last winter for observation and the cystoscope showed an area not as large in extent, but

at the same site. Dr. Smith fulgurated this case and she was relieved. We cystoscoped her about three weeks ago and she showed a small area with three or four sloughing points, but her frequency, which had been ten to twelve times each night, was reduced one-half. In microscopic secretions made at the time of resection it showed involvement of the deeper coats. So it seems that fulguration in the handling of these cases does quite as well as resection.

Dr. Francis R. Hagner (Washington, D. C.): I have had several cases of this kind that have been operated by excision and they have everyone returned. I had one woman who went two years perfectly well, who was relieved from getting up eight to ten times at night. The frequency returned again and the cystoscope showed practically the same condition as before operation. I have another patient that I have been fulgurating about every three months for two years. She will be pretty well for a month and a half or two months, and then the symptoms of frequency and pain will return. None of these cases have been permanently cured either by excision or by fulguration.

Dr. William A. Frontz (Baltimore): In most cases in our experience that have been relieved by such treatment as fulguration and hydraulic distention the lesion has been confined to the mucous membrane. I think the type of case that Hunner originally reported have been deeper lesions, and I do not think in those cases treatment of this sort results in permanent success. In those cases I believe resection is necessary. We found in a considerable series of cases—I have forgotten the number, 12 or 15—that in those treated by hydraulic distention and fulguration the relief of symptoms are temporary, while after the resection of the area involved the relief is permanent.

In regard to the recognition of these cases so far as the lesion is concerned, I think distention of the bladder shows only the position in which the lesion occurs, that is to say, the part of the bladder to resect, and that with over distention of the bladder

you will find fissure resulting from the over distention. There is present in those cases a submucous fibrosis which on distention results in a fissure from the mucous membrane into the submucosa. It is a lesion parallel to the lesion that one finds in the urethra very often.

Dr. A. J. CROWELL (Charlotte): I would like to ask Dr. Stevens how he would handle a case which recently came under our care. He had been fulgurated for a Hunner ulcer, and following this there was considerable relief, and the symptoms returned. Dr. Hunner then did a resection. Six or seven months thereafter this young man came under our care suffering in the same way as before operation. Cystoscopy shows a rosette of ulcers around the scar left by the former operation. The young man is under our care at present and I do not know what to do for him. If Dr. Stevens can suggest some plan of treatment which will enable us to cure this young man, I shall appreciate the favor very much, indeed.

Dr. HENRY H. BUGBEE (New York City): I feel that Dr. Stevens is decidedly to be congratulated upon his remarkable results in this case. As Dr. Stevens said, I saw this case with him at one time. The man was suffering from most distressing symptoms. I have never seen a patient suffer as that one. His bladder was very much contracted and the lesion was very extensive, and while resection was undoubtedly the only procedure that could possibly give him relief, I felt very skeptical about the end result. I feel the results Dr. Stevens has obtained are due to his very careful observation of the case and exceeding skill in surgical procedure. The way in which the bladder is stretched up so the patient can go all night without voiding, when the bladder would not hold more than an ounce before operation, shows what is possible even with such a contracted organ.

Dr. A. R. STEVENS (closing): It seems to me that the reported cases of Hunner ulcer that have been cured by fulguration and

other simple measures probably have very superficial lesions, but we have no proof of that. This one that I reported, although it was of only five months' duration, had a very dense looking fibrous tissue from 0.5 to 0.75 centimeter in thickness. I doubt if anybody can cure that by fulguration of a few spots of the overlying mucosa. If any one could discover some method of differentiating the superficial cases from those that affect deeply the bladder wall, then we would begin to know which ones to tackle with simple measures and which ones to go after at once.

As matters stand, it seems to me the part of wisdom to try the simpler methods of treatment in all cases, and if that does not afford relief, then open the patient up and do what is necessary.

Concerning the case Dr. O'Neil spoke of, I wonder if that case did not have chronic urethritis. That would explain frequency of urination in spite of large bladder capacity. I had one patient who required urethral treatments before the maximum good result was obtained following operation for Hunner ulcer.

HEMORRHAGIC SEPARATION OF RENAL PARENCHYMA

ROBERT C. BRYAN

J. C. A., locomotive engineer, aged fifty-two, 6 feet and weighs 190 pounds, was referred to us February 19 by Dr. M. O. Burke for hematuria. The patient had noted some blood in the urine just two weeks previously, on February 5. At that time he had a bad cold and thought possibly the discoloration was due to some cough syrup he been taking. The blood has been constant during the last two weeks in the urine, at times making it a light tea color and at other times of a dark coffee appearance. He has noticed that the urine seems to be more clear in the morning and occasionally there is a clot, which has appeared only in the morning and which is round and hard like the broken off end of a pencil. He thinks that on one or two occasions in the last two weeks the urine has started off a dark chocolate color only to clear up during the act of urination, but he is not altogether positive about this. He has had no pain whatever at any time and is at a loss to understand why the urine is so dark.

Family history. Parents living, in good health. Two brothers living, in good health. No history of tuberculosis, paralysis, diabetes or insanity. Wife died of cancer at age of forty. No other history of cancer in the family.

Past medical. Usual diseases of childhood. No pneumonia, no typhoid, no malaria, several attacks of bronchitis but no pleurisy. Repeated attacks of rheumatism of right shoulder, this may be purely a muscular condition as patient is an engineer and exposes the right shoulder by leaning out of the cab window.

Past surgical. Negative.

Gastrointestinal. Appetite good, bowels regular, no epigastric pains, no nausea or vomiting, no diarrhea or dysentery, no blood in stools, no attacks of indigestion.

Cardiorenal. No dyspnea, no expectoration nor hemoptysis nor chronic cough, but is subject to colds about twice a year.

Genito-urinary. Absolutely negative up to fifteen days before reporting, and he further denies any venereal history.

Marital. Three children living and healthy.

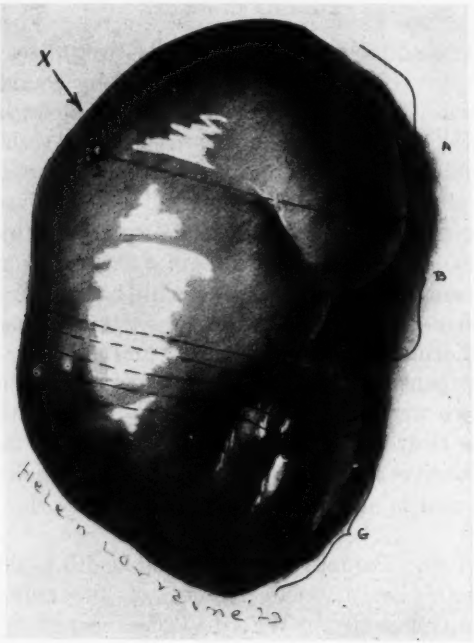


FIG. 1. VIEW OF KIDNEY WITH THE SOLITARY TUBERCULAR AREA ABOVE

The transverse lines through the lower pole below indicate the location of the hemorrhagic wave.

Habits. Railroad engineer. Smokes ten to twelve cigarettes daily, drinks two or three cups of coffee a day, and is a very moderate user of alcohol, if at all.

Present illness. He states that on the day previous to his first notice of the change in the color of the urine, that he had made a trip to Washington and back on an engine that was

extremely rough riding, throwing him from side to side in his cab, and always in leaning out of the cab, the edge of the window-sill catches just below the ribs of the right side, but he has never experienced any tenderness or soreness in this region, and has become thoroughly accustomed to leaning out of the window in

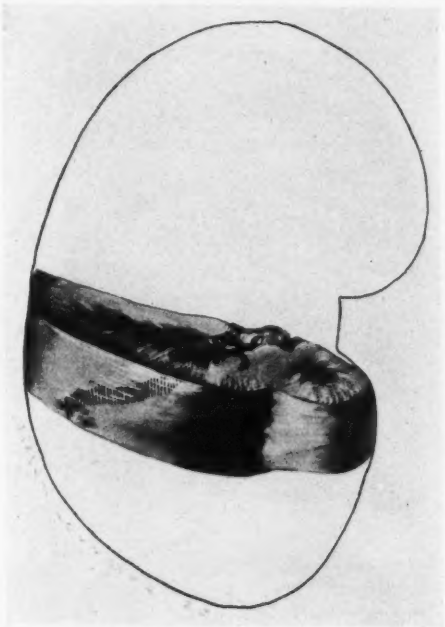


FIG. 2. SECTION THROUGH THE LOWER POLE

this position and putting most of his weight on his side. There was no frequency, no pain, or discomfort about the act or urination, he only complained of the darkness of the urine.

Physical. Patient lying in bed, apparently perfectly comfortable, not seriously sick, answers questions readily, is about middle age. Head negative; eyes react normally; nose and ears negative; tongue coated, true to midline; teeth fair, several missing, some evidence of pyorrhea, smokers throat, tonsils

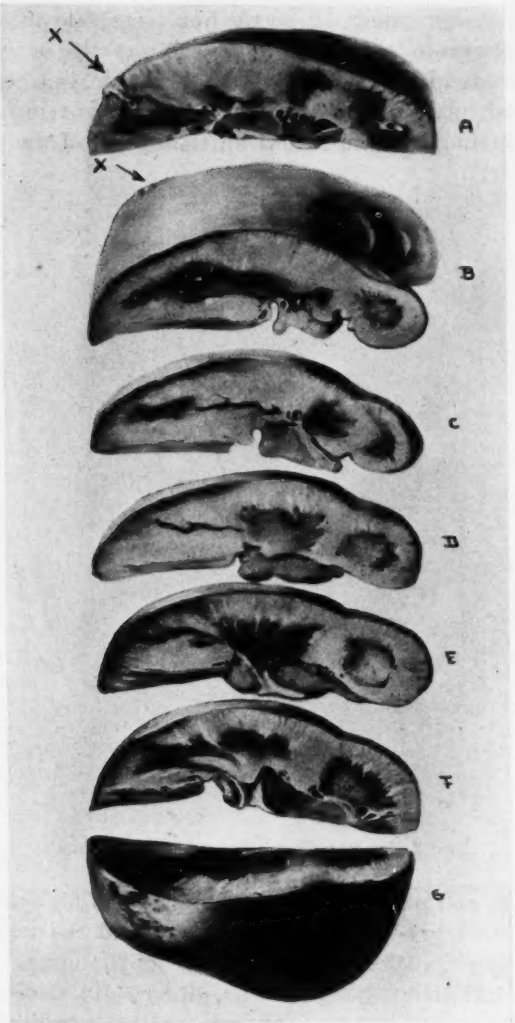


FIG. 3. SERIAL SECTIONS SHOWING THE TUBERCULAR AREA ABOVE X; THE HEMORRHAGIC WAVE THROUGH LOWER POLE

buried but no expression. Skin and mucus membrane somewhat pale. Glandular, posterior cervicals palpable, otherwise negative: Thorax, expansion free and equal, lungs are negative. Heart, no increase in cardiac dullness, apex deep, just within midclavicular line, fifth midinterspace, sounds regular, somewhat distant, no murmur is heard. Blood pressure, systolic 134, diastolic 82. Pulse regular, fair volume, rate 72. Abdo-

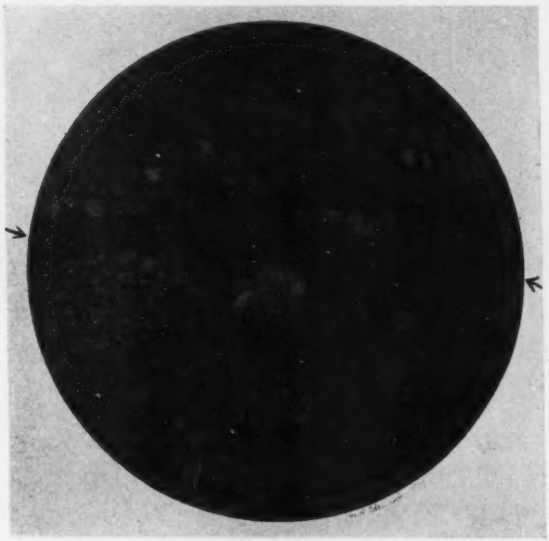


FIG. 4. HEMORRHAGIC WAVE THROUGH LOWER CORTEX

men rotund, no palpable masses, liver, kidneys and spleen not mapped-out, no abdominal tenderness. Extremities negative, reflexes equal and normal, and there is no varicocele on either side.

Rectal examination. The prostate is slightly enlarged and softish, the lobes of equal size, normal consistency, the notch is well defined, the gland is movable and not painful, and there is no expression.

Cystoscopic examination. Urethra takes No. 24 French cystoscope with a little embarrassment about the prostatic urethra which is readily overridden. The crescentic, well defined, slightly engored lobes of the prostate are seen presenting in the field, the mucosa of the bladder is normal, of the usual pinkish-salmon color, there are no trabeculae, no mucus extrusions, no growths, no stone; the inter-ureteral bar is located and the

FIG. 5. LARGER HEMORRHAGIC STREAK THROUGH MID-CORTEX

left ureteral os, which is normal, is catheterized with a No. 6 French catheter, which mounts without apparent pain, spasm or trauma to the pelvis of the kidney from which there is an immediate flow of amber colored clear urine. The right os is extremely small, is located with considerable difficulty, only when it opens up for the expulsion of urine, at which time the discoloration of the blood may be seen whirling into the bladder. A No. 6 French leaded catheter being arrested at about 20 cm., which we take to be due to the actual tightness of the ureteral

os, and since it will go no further, it is removed and a No. 5 French catheter is inserted to the pelvis easily, and from it there is a bloody stained urine of a bright cherry-red color. One and five-tenths cubic centimeter of a 0.4 per cent solution of indigo-carmine is injected into the median basilic vein of the left arm and appears in the urine of both sides in just five minutes. The right kidney is now irrigated with a 1:2000 adrenalin

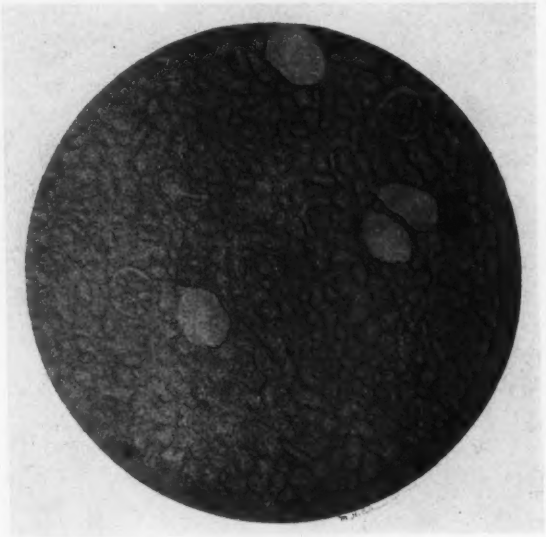


FIG. 6. PRACTICALLY NORMAL RENAL TISSUE THROUGH THE CORTEX OF THE KIDNEY ELSEWHERE

solution and 2 cc. are held in the pelvis of the kidney for three or four minutes. The patient is taken to the X-ray room and with the graduated burette 6 cc., of a 25 per cent solution of sodium bromide is gravitated into the pelvis of the right kidney and pyelogram taken.

Urinalysis. Left side: Color, straw; slight cloud; sediment, scant; acid; albumin, small amount: blood, good many cells: pus, occasional cell; crystals, 0; amorphous matter, 0; casts, 0;

cylindroids, 0; epithelial cells, good many large round; mucus, no excess; other sediment, 0. *Remarks:* No bacteria found in stained sediment. *Right side:* Color, smoky red; very cloudy; sediment, heavy red: acid; albumin, abundant; blood, bulk of sediment; pus, occasional cell; crystals, 0; amorphous matter, 0; casts, 0; cylindroids, 0; epithelial cells, few large round; mucus, no excess; other sediment, 0. *Remarks:* No bacteria found in

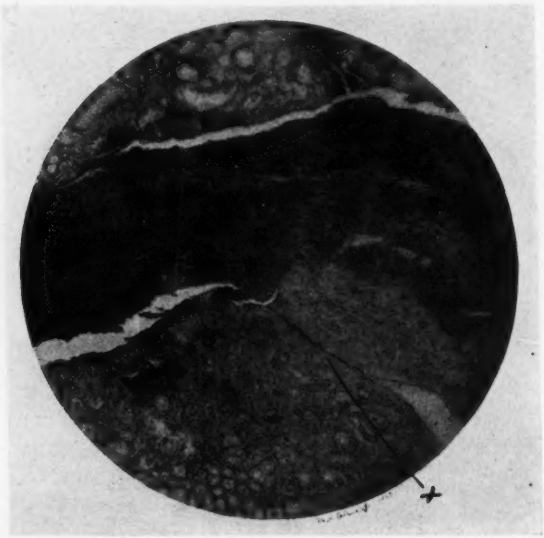


FIG. 7. BLOOD STREAK NEAR THE CAPSULE WHICH IS BLOCKING OFF THE VESSEL BY EXTERNAL PRESSURE AT X

stained sediment. The number and appearance of the round cells suggest the possibility of some of them being tumor cells.

X-ray report. Dr. F. M. Hodges reports "the kidney is enlarged but the pyelogram is small. There is one area which is suspicious of tumor, since the pelvis seems to be pressed upon. This is not, however, perfectly definite; but in view of the history, believe it is enough to indicate operation."

Kidney function by the phthalein test. Output first hour 350 cc., second hour 500 cc., total output 850 cc. Percentage first hour 25 per cent, second hour 15, total percentage 40.

Wasserman negative. The blood chemistry is negative. White blood count 8200, polymorphonuclears 74, hemoglobin 65 per cent Sahli, and red blood count 4,000,000.

FIG. 8. ANOTHER VIEW OF FIGURE 7 WHICH SHOWS THE HEMORRHAGIC WAVE BELOW AND THE ACTUAL SEPARATION OF THE RENAL SUBSTANCE

It is at X that the endothelial lining is lost

In consideration of the persistent hematuria, the enlarged kidney, and the evident flattening of the superior calyx by X-ray, the progressive anemia and lowering of hemoglobin index, radical intervention was decided upon, the provisional diagnosis being hypernephroma of the upper pole.

Operation. March 2, 1923, 0.25 grain of morphine was given at 11:30 and at 12 o'clock anesthetic, etherdrop method was administered by Miss Creelman, assisted by Dr. Creekmur, right

kidney incision. There was considerable fat, kidney was found to be very high so that the lower pole does not reach the upper end of the wound. The perirenal fat is incised and the kidney stripped loose and dislodged down with some difficulty, but can never be thoroughly dislodged. Its appearance is normal, there are apparently no aberrant arteries, the pedicle is seized *en masse* with the kidney forceps and the organ excised. Cat-

FIG. 9. THE SOLITARY TUBERCULAR AREA, GIANT CELLS, EPITHELIOD CELLS, ROUND CELLS, AND CASEATION

gut No. 2 double ligatures are put about the pedicle and securely tied, and a tube carrying a wick of iodoform gauze is placed in the kidney bed for drainage. Tissues brought together with catgut No. 2, silkworm gut through the skin. Section of the kidney showed no pathology macroscopically.

Kidney function, March 15, 1923. Output for the first hour 124 cc., second hour 200 cc., total output 325 cc. Percentage for the first hour 45 per cent, second hour 25, total percentage 70.

Dr. S. W. Budd reports the following: Kidney (right) received in formalin. Color, size and general appearance of the organ is

FIG. 10. PYELOGRAM

Note the constriction of the superior calyx

altered by the preservative fluid. Kidney measures 12.5 cm. by 8 cm. by 5 cm. The surface of the organ is smooth except

for a couple of small scars near the lower pole of the kidney and one raised area near the upper pole. This raised area extends about 0.2 cm. above the surface and measures from 0.5 to 1 cm. in diameter, and is composed of different tissue from the renal parenchyma and is surrounded by a reddish vascular zone from 1 to 2 cm. in thickness. A section through this portion of the kidney shows a yellowish gray wedged shaped zone with its base at the cortex and its apex pointing towards the pelvis extending into the substance of the kidney for a distance of 1cm. The capsule of the kidney strips readily and there is no tendency for it to be adherent to the underlying cortex.

The kidney is divided by a longitudinal section extending from pole to pole. The general appearance of the organ is normal. The glomeruli, the medullary rays and the cortex, are easily seen. The large blood vessels are normal. The kidney is sectioned from pole to pole by a number of transverse cuts about $\frac{1}{8}$ inch apart. Near the midportion of the kidney but slightly towards the lower pole and posteriorly, a blood streak commences to show itself in the cortex. In the next three to five sections this blood streak occupies different portions of the kidney substance and finally ends in the pelvis of the kidney. The blood streak is not surrounded by a vessel wall and it pursues a most tortuous course from the capsule to the pelvis of the kidney. In the region of the blood streak there is no evidence of any unusual tissue. In fact in this region the cortex corresponds very closely to that found elsewhere in the organ. The blood streak varies in thickness from 1 to 3 mm. and the thickest portion is near the capsule of the kidney.

Microscopic examination of the cortex about the blood streak shows nothing unusual. While there is a mild degree of cloudy swelling in this region it exists elsewhere in the kidney. There are several dilated venous sinuses in the midcortex region. These sinuses have extremely thin walls, are several hundred microns in diameter and are lined by prominent endothelial cells. One of these sinuses leads directly down to the blood clot and from all appearances opens into the blood clot in a funnel shaped manner, the stem of the funnel, being approxi-

mately 50 microns in diameter, is directed towards the sinus while the larger portion of the funnel isseveral hundred microns in diameter and points towards the blood clot. In this sinus are many blood cells and some blood that has undergone a hyalin transformation. The blood streak itself consists of altered blood cells, some very fresh and others that have under-

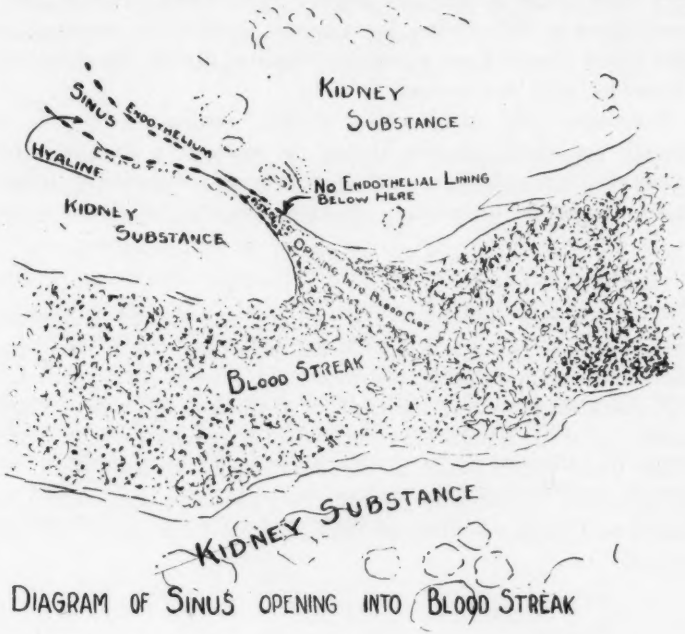


FIG. 11

gone disintegration. There is considerable fibrin and also a number of leucocytes that are showing phagocytosed blood pigment. The blood streak is followed by a number of sections through its entire course. There is no evidence that the blood streak is encased in a vessel wall. Examination of the cortex quite remote from the blood streak shows a mild cloudy swelling. There is not an excessive amount of blood in the kidney and

the renal tubules are free from blood. The glomeruli show a normal amount of blood. There is no increase of renal stroma. A section through the solitary wedge-shaped, yellowish-gray nodule, shows a typical local tuberculous process. There are a number of giant cells epitheliod cells and areas of caseations. There are many tubules, some in a very early stage and some in a later stage in this one patch. The whole mass is that of conglomerate tubercules in various stages of development. The blood vessels show a slight subintimal fibrous tissue increase. Otherwise they are normal.

Diagnosis. (1). Mild grade cloudy swelling (there is not enough pathology in the kidney to warrant a diagnosis of a hemorrhagic nephritis). (2) Hemorrhage originating from a small cavernous angioma. (3) One solitary tuberculous area.

DISCUSSION

Since we can disregard the solitary segregated tuberculous area, which is located on a different pole from the blood streak, the condition apparently resolves itself into a consideration of only two states: (1) Actual rupture of the kidney from moderate trauma, and (2) separation of the renal parenchyma by a hemorrhagic wave which found its exit most easily towards the pelvis, the origin of which was probably a cavernous angioma. Prolonged and repeated study of the specimen leads us to the latter opinion.

DISCUSSION

Dr. Benjamin S. Barringer (New York City): From the pictures it is difficult to say what happened, but it seems to me this was a rupture of the kidney from trauma. It looked like traumatic crack across the kidney and hemorrhage into the crack.

Dr. Robert C. Bryan (closing): I thought of that at first and worked along that line, but there was no evidence of any pathology elsewhere, and this very clear linear separation with uniform extravasation of blood led us to think that there was possibly an actual separation of the renal parenchyma by a hemorrhagic wave. The man was a locomotive engineer and he was in the habit of pressing his right side, and consequently the kidney, against the window-sill of the cab. This hemorrhage followed the line as is well shown in the picture, and we were inclined to believe it was not a subcapsular fracture, but rather a shoving aside of the kidney tissues by a hemorrhagic wave, although it may have been a fracture which, however, showed no traumatic evidences elsewhere.

REPORT OF A CASE OF A SOLITARY CALCIFIED CYST OF THE KIDNEY

WILLIAM WARREN TOWNSEND

Burlington, Vermont

For the privilege of showing this specimen and slides and in the preparation of the case history, I am indebted to Dr. C. F. Ball, a young surgeon of Rutland, Vermont. My connection with the case was that of consultant and assistant at the operation.

Family and personal history. Father died of accidental burns, mother at eighty-three years of age of senile debility, four brothers of accidental causes. One brother and several sisters living. Patient always healthy as a girl and young woman. No serious illnesses except for smallpox when a girl. Mother of nine children. One miscarriage.

Present illness. Present trouble first noticed about twenty years ago shortly after the birth of her last child. At that time patient weighed about 140 pounds, which weight was maintained up to about eight years ago. Presence of a lump in the left flank without distress was the first manifestation observed by the patient. Mass in left flank grew at first very slowly in size, later changing its characteristics to a hard mass instead of former softer consistency. The tumor mass did not at first cause either abdominal or renal distress and not until about two years ago did it become distinctly bothersome. At that time patient began to have pain in the bowels especially in left flank with a varying amount of disturbance of bowel activity. Pain became severe enough to require morphine instead of other sedatives for its control early last fall. Following the use of morphine, cathartics and enemata were more regularly required than formerly. Pain for which morphine was administered began in the left flank radiating posteriorly into the lower dorsal and upper lumbar region. Patient never has had a temperature or a manifestation of chills during the course of her illness.

Physical examination. Patient poorly nourished and somewhat anemic, bolstered up in bed on pillows with heart and lungs negative except for rather pronounced calcification of temporal and radial arteries. Abdomen, in prone position, quite distended and somewhat tympanetic. Palpation negative except for presence of tumor mass in left flank in region of lower pole left kidney. Bimanual examination, with a hand anteriorly and one posteriorly, tumor was found to be movable within certain limits. Nervous system negative except for a slight sluggishness of reflexes. Patient advised to go to hospital for further observation.

Hospital data. White, American, female, sixty-two years old, married, 5 feet, 2 inches tall, weighed 100 pounds. Admitted to hospital February 9, 1923.

X-ray examination. X-ray examination at my office in route to hospital, disclosed a large calcified mass in left flank. After several days treatment at the hospital, on February 20, another X-ray examination was made. Three days prior to proposed examination patient was given a tablespoonful of barium sulphate with each meal in order to determine a possible accumulatory effect in colon above tumor mass. No such accumulation, however, was observed on the 20th, the day of the fluoroscopic examination. A barium enema was then given to determine patulency of colon from below. No hindrance to the passage of up over and around tumor mass was observed. A complete colon examination could not be made on account of the patient's inability to retain only a small quantity of the barium enema. Sufficient quantity, however, was introduced to make possible an elimination of tumor mass as having any direct connection with the sigmoid—sigmoid was readily movable over and around anterior outer surface of tumor mass.

Cytoscopic examination. A cystoscopic examination was made for the purpose of determining the possible relation of the tumor mass to the left kidney. The left ureteral orifice would not admit the passage of a catheter and after rather protracted effort, examination was discontinued.

Pre-operative diagnosis. Calcified cyst, left flank, probably from lower pole left kidney.

Operation. On March 3 assisted by Dr. W. W. Townsend, patient was placed on right side with elevation of flank and incision made about 2 inches above crest of ilium running backward and upward for a distance of 3 inches. Tumor mass was reached extraperitoneally and found to be connected to lower pole of left kidney, whereupon incision was extended posteriorly upward completing the usual curved lumbar incision of a regular kidney approach except for being made in reverse direction. Through the enlarged opening tumor mass was delivered and enucleated, after having made an opening through capsular connectve tissue. A rubber covered clamp was placed on lower pole of kidney during enucleation. After tumor mass was removed, two mattress-sutures were placed in lower pole of kidney and capsule closed with a running No. 2 chromic catgut suture. Clamp removed with but slight oozing. Wound packed with long strip of gauze surrounded by rubber tissue at exit through superficial tissues.

Laboratory findings. February 13. Red blood cells 3,560,000; white blood cells 13,000; hemoglobin 60; polynuclears 72 per cent; mononuclears 1 per cent; transitionals 1 per cent; small lymphocytes 20 per cent; large lymphocytes 6 per cent. Urine negative.

March 6. Urine examination: specific gravity 1022; acid reaction; trace of albumin; urea 1.9; chlorides and phosphates diminished. Microscopically: few erythrocytes; few pus cells; few bladder and renal epithelia; numerous coarse and brown granular casts.

March 24. Urine: specific gravity 1020; acid reaction; urea 1.4 grams; chlorides increased; very slight trace of albumin. Microscopically: erythrocytes very rare; small amount of pus; only a few hyaline and fine granular casts.

Subsequent history. Patient made a very favorable immediate post-operative recovery with complete relief of pain and abdominal distress. Continued to improve for a period of five weeks following which, patient suddenly collapsed, dying April 9. Death, primarily due to myocardial insufficiency with a contributory arteriosclerosis and late operative shock.

THE SIMULTANEOUS OCCURRENCE OF TUBERCULOSIS, CALCULUS AND PAPILLOMA IN THE SAME KIDNEY

RICHARD F. O'NEIL

Boston, Massachusetts

In Cabot's Modern Urology (1) published in 1918 in the chapter on Renal tuberculosis, I made the following statement, "While undoubted instances of simultaneous occurrence of renal calculus and renal tuberculosis, and the development of renal tuberculosis in a kidney previously the site of calculus, are found in the literature, the conditions are rare. In 256 cases of renal calculus and renal tuberculosis reported from the records of the Massachusetts General Hospital, no cases of true calculus were found in tuberculous kidneys as opposed to the calculous deposits, nor were there any cases of the development of tuberculosis in kidneys from which calculi had been removed."

Since then Dr. H. A. Fowler of Washington reported before this Society in 1920 a case of tuberculosis of the kidney complicated by impacted pelvic calculus (2). In the discussion that followed other cases of the occurrence of true stone and tuberculosis of the kidney were mentioned by Caulk, Kretschmer, Gardner and Braasch, showing that the condition is not as rare as would seem.

Still the occurrence of true calculus associated with renal tuberculosis in contradistinction to the caseous deposits seen at times in such kidneys is sufficiently uncommon to warrant reporting the following case. The pathology is unique as there was also present a beginning true papilloma in the pelvis of the kidney.

The calculus in this case was a smooth hard one, in one of the calices. It gave a faint but typical shadow in the X-ray. It is to be regretted that no chemical examination of the calculus was made. The symptoms and urinary findings being typical of

tuberculosis no particular attention was given to this shadow previous to operation.

Case history. Male, Italian, forty-four, married, cobbler by trade. Entered the Massachusetts General Hospital Genito Urinary Service March 30, 1923, with the diagnosis, right renal tuberculosis.

Family history. Negative.

Previous history. Negative except for attack of gonorrhea fourteen years previously. Right epididymitis which became chronic, then "broke and ran" for a while. (Tuberculous?)

Present illness. Two years ago pain in suprapubic region accompanying micturition. Later frequency of micturition, at present seven to eight times during the day, three to four times at night. Occasional pain in right loin radiating to groin (possibly due to the presence of the calculus). No gross hematuria, no loss of weight or appetite. Patient has worked up to time of entrance.

Examination. Rather anemic looking but well nourished man. Chest negative. Abdomen negative except for slight tenderness over right kidney. Right epididymis thickened, healed scar of old sinus in scrotum. Blood pressure 118–58. Renal function 65 per cent. Wassermann negative. Bladder urine, cloudy, 1016, no sugar, albumin trace. Sediment, much pus, moderate number red blood cells. No tubercle bacilli found. Cystoscopy: Bladder practically normal. Both ureters catheterized easily. Urine from right kidney, moderate amount of pus, considerable number of red blood cells. Urine from left kidney, occasional red blood cells (traumatic); no white blood cells. Renal function, right kidney 25 per cent; left kidney 45 per cent. Guinea-pig inoculation from right kidney, autopsy positive. From left kidney, autopsy negative.

Operation. April 2, 1923. Dr. R. F. O'Neil. Right lumbar nephrectomy. Gas oxygen anesthesia. Convalescence uneventful. Patient discharged from hospital twenty days after operation.

Pathological report by Dr. H. F. Hartwell, pathologist to the Hospital: "A kidney and a portion of the ureter. On section the calices and pelvis are dilated. There is an oval pale yellow calculus in one of the dilated calices. It is about the size of a plum stone. The mucosa of the pelvis is thickened and occasionally shows a small papillary elevation. The kidney markings are distinct. A microscopic examination shows the pelvis and adjoining portion of the medulla infiltrated with wandering cells among which occasional focal collections of epithelioid and

giant cells are found (plate 1). There is little caseation. The pelvic mucous epithelium is hyperplastic and from one portion there is a small papillary outgrowth composed of atypical epithelial cells in a slender fibrous frame work (plate 2). There are no noteworthy changes in the cortex. A section of the ureter shows its walls thickened by fibroses and wandering cells with clusters of tubercles.

Tuberculosis of the kidney and ureter. Nephrolithiasis. Papilloma of the pelvis.

REFERENCES

(1) CABOT: Modern Urology, vol. ii, p. 495.
(2) FOWLER, H. A.: Tuberculosis of the kidney complicated by impacted pelvic calculus. Trans. Amer. Assoc. Genito-Urinary Surg., 1920.

PLATE 1

SECTION OF KIDNEY SHOWING TUBERCULOSIS

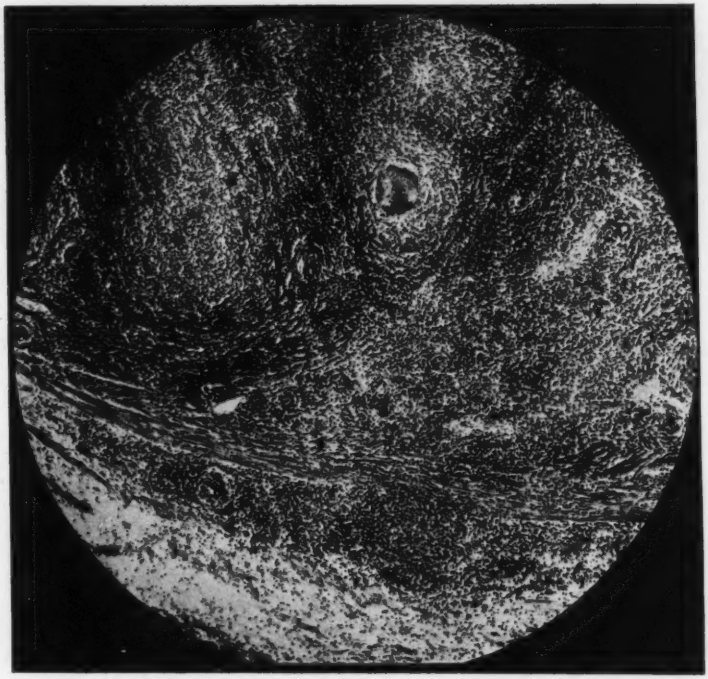
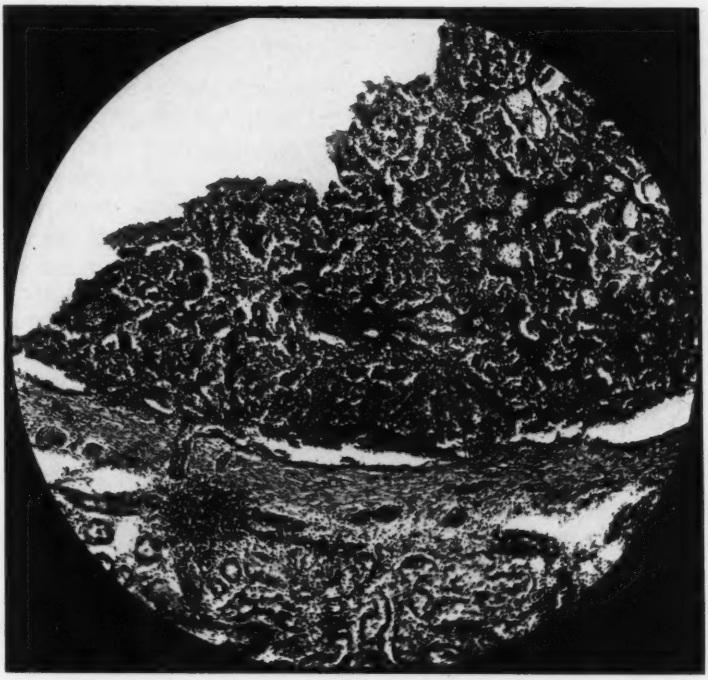


PLATE 2

SECTION THROUGH PELVIS SHOWING PAPILLOMA ARISING FROM PELVIC MUCOUS MEMBRANE



ECTOPIC KIDNEY

R. F. O'NEIL

Boston, Massachusetts

Ectopic or congenitally misplaced kidney is due to the failure of the kidney to rise to its proper location during fetal development. I shall not attempt to discuss the embryological features.

The condition is comparatively rare but has been known since very early times; the early descriptions being of anatomical interest only. Its clinical importance has increased with the introduction of modern diagnostic measures and the majority of clinical cases have been reported since 1898 or 1900.

The relative frequency of the occurrence of ectopic kidney is variously estimated to be from 1 in 1000 to 1 in 2500 cases.

They present certain anatomical points of interest, one of these being the blood supply in which there is much variation both as to its origin and the number of blood vessels. The origin of the blood supply is always from a lower point than is that of a normal, even if freely movable, kidney. The vessels are not infrequently multiple and arise from the lower portion of the aorta, the common iliac or the mid sacral, or any two or three of these. The veins generally accompany the arteries. The ectopic kidney may be normal in size but is generally smaller and the fetal lobulations are often preserved. The pelvis is apt to be smaller than normal, when not hydronephrotic, and undeveloped. The ureter is always shorter than normal, is tortuous in its course but generally enters the bladder at its normal position. Statistics go to show that clinically the condition is more frequent in women than in men. At autopsy, however, the condition is found to occur with equal frequency. This is undoubtedly due to the fact that in women ectopic kidney frequently gives rise to symptoms simulating some lesion of the uterus or tubes. Genital malformations not infrequently accompany this condition. The ectopic kidney

is generally located in the true pelvis or the iliac fossae. It is said to be more common on the left.

These kidneys when normal as a rule give rise to no symptoms although a pelvic kidney may interfere with the development of the pregnant uterus. In a series of 19 cases reported from the Mayo Clinic in 1918 by Judd, 9 were operated for some lesion of the kidney, the other 10 discovered at operation for some other condition, or found at routine examination of the urinary tract and gave rise to no symptoms.

They are subject to all of the lesions of the normally placed kidney and when diseased give rise to the typical symptoms of such lesions if they be properly interpreted. From their position they are apt to become hydronephrotic. They are to be differentiated from a markedly movable kidney and are to be diagnosed by a careful routine examination of the urinary tract in the presence of symptoms, or in the absence of urinary symptoms, by the employment of cystoscopy and the pyelogram to determine the causes of obscure abdominal or referred pain or suspicious pelvic tumors.

The treatment of ectopic kidney causing symptoms should be that of the conditions occurring in normally located kidneys when possible.

As a matter of fact this consists of nephrectomy in the majority of cases provided the other kidney is adequate, as their position and immobility due to a short pedicle and abnormal blood supply renders the ordinary operations as suspensions, plastics or pyelotomy difficult and unsatisfactory, not infrequently requiring secondary nephrectomy, the difficulties of which are much increased.

The 2 cases herein reported are of interest from a diagnostic point of view, there being no urinary symptoms in either case and only a slight abnormality of the urine; pain being the predominant symptom in both, in 1 case present for twenty years referred to the left leg and thigh, in the other the appendix region, the appendix having been removed with no relief. One case was in a male, the other a female, one on the right and one one the left. There were no genital or other deformities in either

case. Both were treated by nephrectomy with complete relief of symptoms, one being a hydronephrotic kidney situated in the mid sacral region and which contained a calculus; the other a hydronephrotic kidney situated in the right lower quadrant on a line with the crest of the ilium.

Case 1. Male, aged forty-eight, Russian, tailor. Entered Genito-Urinary Service, Massachusetts General Hospital, February 8, 1923.

History of intermittent pain in the left leg and thigh for twenty years. For the last two years this had become almost constant and of late incapacitating. Patient had been seen by the Surgical, Orthopedic and Medical Departments and no cause for symptoms found. Several teeth had been extracted; no relief from this procedure. Referred to the Genito-Urinary Department for an examination of the urinary tract as cause of pain.

The X-ray (plate 1) showed an irregular dense shadow in the mid sacral region to the left, thought to be a calcified gland. There were no urinary symptoms. The urine was clear; no albumin; no sugar; sediment, 6 to 7 red blood cells to the field.

Cystoscopy. Dr. O'Neil. Bladder and ureters normal. Catheter on left did not go as far as catheter on right. Normal flow of clear urine from each kidney; 10 cc. from left.

Sediment, right kidney, rare red blood cells. Left kidney, a few red blood cells, a few clumps of pus cells. Renal function 12 per cent phenolphthalein from each side in fifteen minutes. X-ray (plates 2 and 3) with catheter in place showed the catheter on the left following an abnormal course after entering the ureter, crossing towards the right, ascending as far as the promontory of the sacrum and returning on itself and being in close proximity to the shadow; the one in the right ureter following a normal course.

Bilateral pyelogram (plate 4) showed a hydronephrosis of a pelvic kidney situated in the mid sacral region and a low right kidney apparently rotated but otherwise not definitely abnormal.

Operation. February 21. Dr. R. F. O'Neil. Gas-ether anesthesia. Curved incision 8 inches long beginning at border of left rectus ½ inch above Poupart's ligament carried parallel with it to the level of crest of ilium. Peritoneum stripped towards median line. Kidney felt deep in mid sacral region in mid line. Could not be lifted into wound on being freed. Convex borders of kidney towards the left, the pelvis posteriorly situated. Blood supply from two sources, one set of vessels

above pelvis from aorta and common iliac, the other below pelvis from common iliac or mid sacral? Vessels clamped, ligated and divided. Troublesome bleeding until this was done due to tearing of a vein in attempt to free kidney. Ureter was not seen as it extended posteriorly. Pelvis cut across at ureter junction and lower portion tied off. Kidney removed; there was a calculus in the pelvis. Operation difficult because of deep location and immobility of kidney and abnormal blood supply. Pyelotomy could not have been done in this case and nephrotomy for stone not done because of hydronephrosis and bleeding. Pathological Report. A kidney 12 cm. long, somewhat irregular lobulations. The pelvis is dilated containing a branched calculus 3 cm. long. The calices are dilated. On section the markings are distinct and the capsule strips. Microscopical examination shows dilatations of the collecting tubules.

Diagnosis. Hydronephrosis. Nephrolithiasis.

For three days after operation patient very uncomfortable from distension and nausea. After this convalescence satisfactory. Patient discharged four weeks after operation. Has been relieved of all symptoms since.

Case 2. Woman, aged twenty-four, single, housemaid. Entered Genito-Urinary Service, Massachusetts General Hospital, March 30, 1923.

Two years ago began to have a dragging sensation in the right lower quadrant. Later on pain and tenderness developed with occasional pain in right hip. One year ago pain became more severe. She was told she had appendicitis and the appendix was removed. There was no relief following this operation, and at present the pain is constant in the right iliac region and of a dull aching character.

Examination. Well developed girl. Chest negative. Abdomen: scar from appendix operation in usual position. Just under this a tender mass about the size of a kidney is readily felt. Neither kidney can be felt in the loins. There are no urinary symptoms. Urine on two examinations showed no albumin, specific gravity 1020; 4 to 5 white blood cells per field.

Cystoscopy. X-ray catheter passed into right ureter.

Pyelogram. Catheter stops just short of level of crest of right ilium, it is further than normal from the median line. Shadow of renal pelvis is abnormal in shape and situated at level and below crest of ilium. No shadows suggestive of stone. Pelvic kidney with deformed and incompletely filled pelvis.

Second cystoscopy. Normal bladder and ureters. Catheter did not go as far on right as on left. Normal flow of clear urine from each side. Renal function: Right kidney appearance twice two minutes 9 per cent phenolphthalein fifteen minutes. Left, appearance time two and one-half minutes. Fifteen per cent phenolphthalein fifteen minutes.

Operation. April 3. Dr. R. F. O'Neil. Gas oxygen anesthesia. Curved incision parallel to Poupart's ligament beginning at the border of the right rectus to above crest of ilium. Peritoneum stripped towards median line. A somewhat lobulated kidney was found toward the median line at the level of the crest of the ilium. It was rotated so that the pelvis presented anteriorly. Ureter short. After freeing kidney, pedicle with only blood supply found at upper pole, this was clamped, tied and divided and the kidney removed. Fixation of the kidney in a higher position was not practical owing to shortness of ureter and the pedicle. Convalescence was uneventful. Symptoms entirely relieved.

Pathological report. A small kidney 8.5 cm. long showing fetal lobulations. The pelvis is dilated. The cortex measures 8 mm. and the makings are distinct.

Microscopical examination shows no definite change.

Diagnosis. Hydronephrosis.

PLATE 1

CASE 1. X-RAY SHOWING DENSE SHADOW TO LEFT OF MID-SACRAL REGION

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PLATE 2

CASE 1. X-RAY SHOWING CATHETER IN CLOSE RELATION TO SHADOW

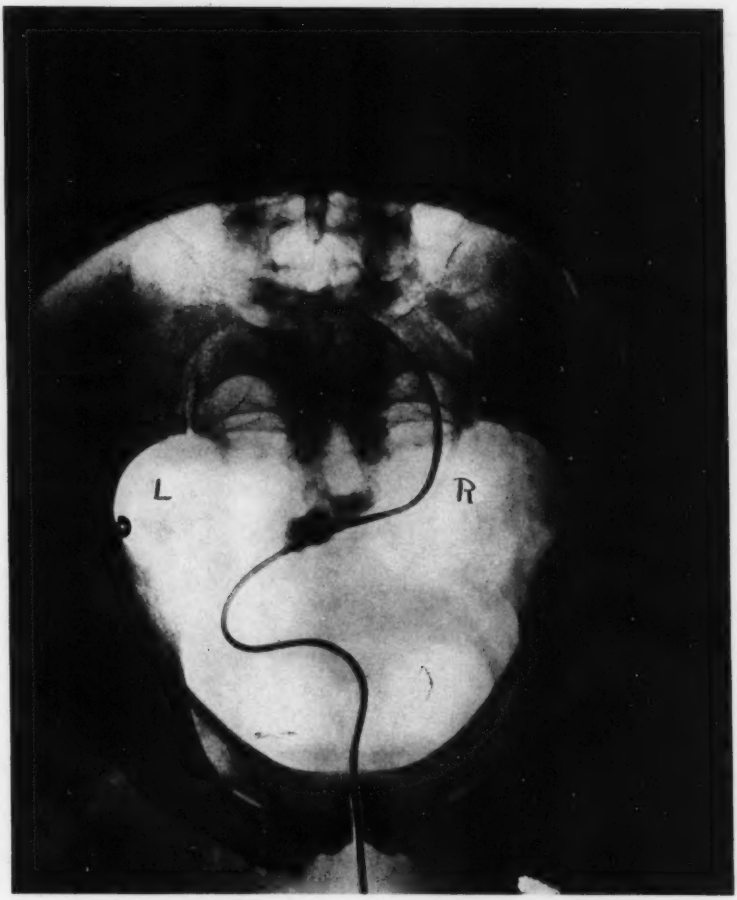
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PLATE 3

CASE 1. X-RAY SHOWING CATHETER IN DILATED PELVIS OF PELVIC KIDNEY

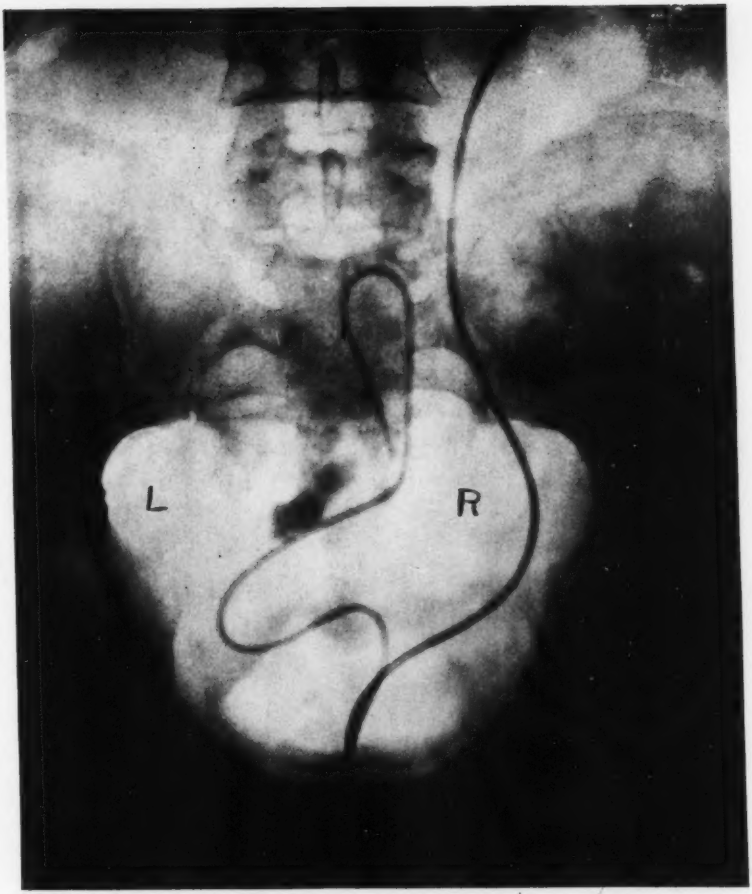
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PLATE 4

CASE 1. PYELOGRAM SHOWING HYDRONEPHROSIS OF LEFT PELVIC KIDNEY, AND TORSION OF LOW RIGHT KIDNEY

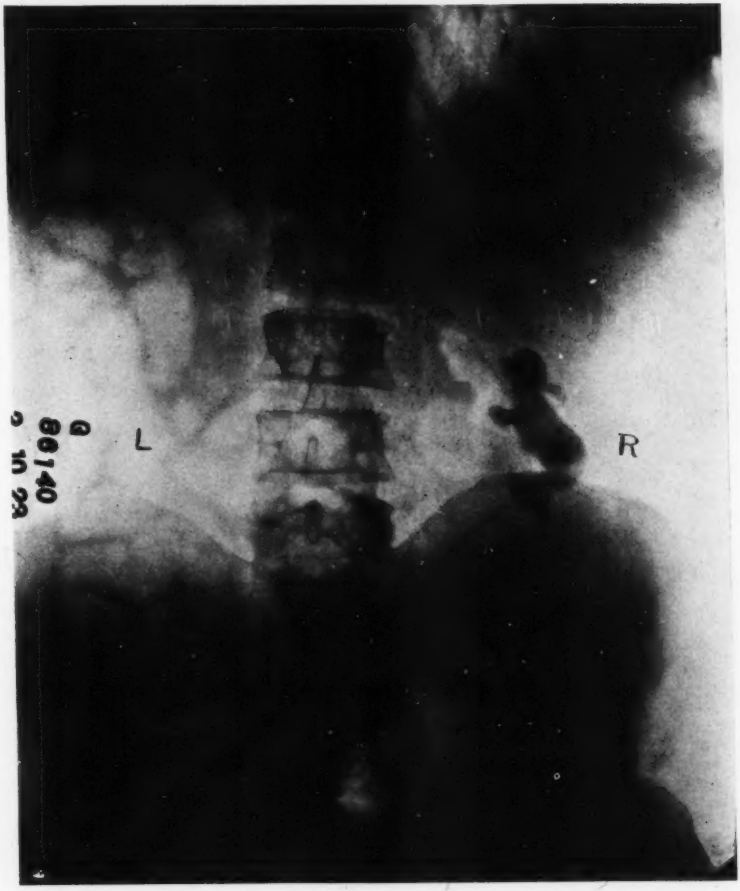
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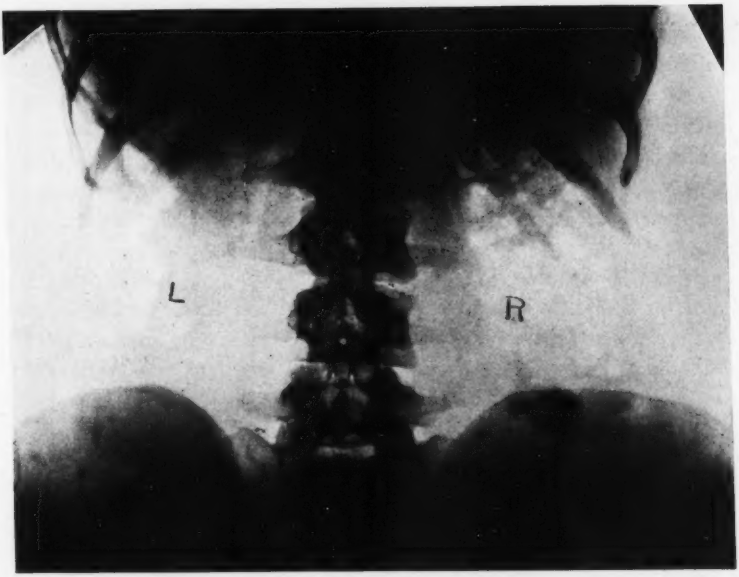
PLATE 5

CASE 2. PYELOGRAM SHOWING ABNORMAL RENAL PELVIS AND ABNORMAL COURSE OF URETER OF ECTOPIC RIGHT KIDNEY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RENAL ANOMALY

THOMAS F. LAURIE

Syracuse, New York

While congenital malformations of the kidneys and ureters are not extremely uncommon, the following case has some interesting features about it which are worthy of note:

A. M., A young Italian twenty-six years of age was admitted to the Hospital of the Good Shepherd July 22, 1921, complaining of pain in the right lumbar region which he had had inconstantly for the past four years, but which had become more severe and sharper in the three weeks previous to admission. The pain had also radiated at times to the penis and scrotum. Three years previous had had some blood in the urine and this had recurred three months previous to admission when he had suffered with difficulty in urinating. There was burning on urination at times and some frequency. He says he had passed small stones on two different occasions. The family history contained no information which had any bearing on the complaint presented. He denied gonorrhea and syphilis but said he had been treated for chancroids seven months before.

The general physical examination revealed a husky young Italian with nothing of note except tenderness in the lumbar region on both sides. The lower pole of the left kidney was palpable and slightly tender. There was also tenderness along the line of the left ureter. The urine contained a moderate amount of pus and some red cells. Roentgenogram showed two small shadows in the region of the pelvis of the left kidney.

Rectal examination revealed a flat prostate, not tender.

Cystoscopic examination showed a bladder which held 6 ounces and a moderate cystitis. On the left side were two ureteral openings about 1 cm. apart; on the right side there was but one ureteral opening normally placed. A No. 6 X-ray catheter was

inserted into the right ureter 30 cm. then two were inserted into the two on the left side. The medially placed one allowed the

FIG. 1. SHOWING THE CATHETER IN THE LATERALLY PLACED URETERAL OPENING INJECTED

catheter to be introduced 30 cm.; the laterally placed one would accept but 23 cm. of catheter. The urine showed a fair amount of pus from the medially placed left ureter, otherwise normal.

X-ray showed the catheters in place and their course before any opaque solution was introduced. The lateral left catheter was injected with sodium bromide 25 per cent and a picture taken

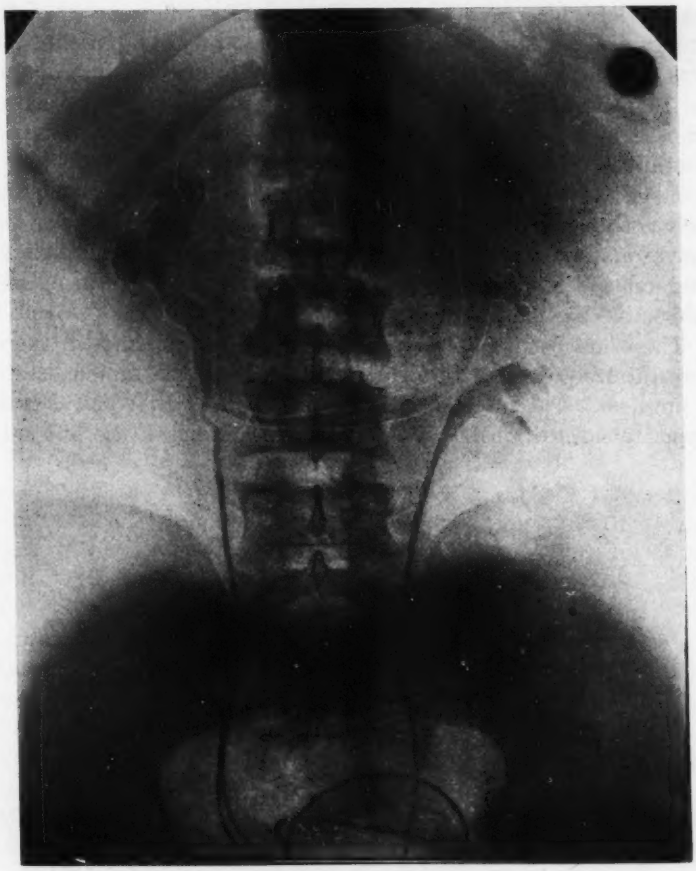


FIG. 2. SHOWING THE CATHER IN THE RIGHT URETER AND THE CATHETER IN THE MEDIALLY PLACED URETERAL OPENING INJECTED

which is here shown. This fluid was drained off and another picture taken with the median left catheter and the right one injected—the result is here shown.

COMMENT

On account of the shadows found in the region of the pelvis of the left kidney and the apparent infection of the upper pelvis on the left side, operation was suggested for the removal of the stones but any kind of surgery was refused by the patient. He was discharged from the hospital shortly after with instructions as to general hygiene. About six months later he presented himself in my office with a small calculus caught in the anterior urethra which was removed through an endoscope.

From the X-ray findings it would appear that we have here four pelves with apparently no fusing of the kidneys—the upper two pelves empty into an ureter which is bifurcated rather high up and on the left side: the lower two pelves empty into their respective ureters.

The exact occurrence of renal anomalies is not known, therefore the frequency of bilateral duplication of the ureters is still a problem. The interesting feature is the fact that pelves from opposite sides drain into one ureter descending on the left side.

DOUBLE KIDNEY AND URETERS

ARTHUR H. CROSBIE

Boston, Massachusetts

By double kidney I refer to the redoublication of the kidney on one side of the body and not to the horseshoe kidney where the two kidneys from the opposite side of the body are fused and all the renal tissue of the body lies in one connected mass.

The subject of redoublication of kidneys and ureters was covered admirably by Braasch and Harpster last year at the meeting of the American Urological Association in Atlantic City. I have little new to add. I have had 1 case which presents an unusual feature. The patient was a young woman of twenty-three years who had had frequent urination as long as she could remember. During the last year she had had several attacks of fever, chills and pain in the left side. She was a poorly nourished woman and looked septic. There was nothing remarkable in the physical examination, except for slight tenderness in the left flank. The urine showed a large amount of pus and colon bacilli. Cystoscopic examination revealed a bladder with the mucosa only slightly reddened. In the region of the left ureter was a mass cystic in appearance about the size of a hen's egg. No orifice could be seen. The right ureteric orifice was normal in appearance and was catheterized with ease. The urine from this side was entirely normal and pyelograms were negative. I was unable to locate any opening in the left side. After injecting indigocarmin there was a suspicion of a faint swirl in the region of the cyst but nothing definite. I then opened the bladder under spinal anesthesia. With the bladder open I was able to see a fold of mucous membrane above the cyst which I could not seen by cystoscope. I introduced a ureter catheter into the fold and found that it slipped with ease apparently into the kidney. A little turbid fluid began to run

through the catheter. I then punctured the cyst with a knife and there was a gush of turbid fluid and the cyst collapsed. On introducing a finger into the cavity of the cyst I found an opening that felt like a dilated ureter. I introduced a catheter into the opening which passed easily up to the kidney. The radiographs and pyelograms showed a double ureter all the way from the bladder to a double destroyed kidney. The catheter introduced into the cyst opening, which was in the lower of the two in the bladder, went to the upper pole of the kidney. I removed this kidney the picture of which I will show. The kidney was longer than normal, but had no external marking to indicate that the kidney was double.

Pawloff in his conclusions mentions the fact that where two ureters enter the bladder the lower ureteric orifice represents the ureter from the upper pole of the kidney. This has been my experience.

All grades of redoublication are found beginning from above and extending downward. The commonest type is the one where there is a single ureter but where the pelvis bifurcates forming two entirely separate sets of calyces. In all these cases of redoublication there is no connection between the upper and the lower set of calyces. This redoublication of the kidney pelvis is not at all uncommon and is not nearly so apt to be accompanied by pathological changes in the kidney, as in the cases where the ureter itself is double. The reason for this is I think that the single ureter is less apt to be interferred with than the double one where the ureter going to the upper pole may be obstructed by the kidney vessels. This I think is the reason why in cases of double ureters there is usually more hydronephrosis in the upper pole.

As I said before there are all grades of redoublication from the double pelvis, the ureter dividing below the double pelvis, and at any point to the bladder where there are two distinct ureteral openings. These ureteral openings into the bladder are usually in the normal position one just above the other or rarely one may have a very abnormal position such as opening into the posterior urethra or into the vagina.

The consensus of opinion seems to be that the division takes place from above downward, that is to say if you have two openings in the bladder you can be assured that you have two ureters extending all the way to a double kidney. Embryologically this seems reasonable the same as in the occurrence of harelip and cleft-palate. You can have a single ureteral bladder opening and a double ureter appearing just above it, but rarely a double ureteral opening in the bladder which unites to form a single ureter. Both Braasch and Chute speak of seeing such a case. Without confirmatory ureterograms it is impossible to state that one ureter had not been obliterated by inflammatory changes.

Statistics show that the most common seat of bifurcation of the ureter is in the lower third. Braasch finds the upper third to be the most common position. That has been my experience. Of course, a low bifurcation is much more difficult to diagnose as it means withdrawing the ureter catheter almost to the bladder in order to have the solution enter both ureters. Doubtless in the past many double ureters have been missed by not withdrawing the catheter far enough. I have been caught twice that way when operating for hydronephrosis, finding double ureter and double kidney which I had not previously expected.

Braasch mentions that these double kidneys usually have some external evidence of demarcation between the two halves. I have failed to note this. In the cases I have seen the kidneys were longer than normal but had no superficial signs of separation. There are a good many cases reported in the literature where there is a distinct separation between the two halves amounting in some cases to a mere fibrous band between the two halves. Where there is this distinct separation a hemineph-rectomy is much more simple than in the cases that I have seen, where there was no external marking and the kidney vessels separated very close to the kidney.

Braasch says that in the cases they have had of tuberculosis of a double kidney, where one-half was apparently diseased and not the other, they have found some tubercles in the apparently

well half. Of course, there are cases such as Braasch reports from the Mayo Clinic where there is a distinct demarcation between the two halves and one is diseased and the other is not. In this resection of the diseased half is possible.

It is interesting to note that formerly cases of redoublication were discovered either postmortem or at operation, while today most of these cases have the diagnosis made before operation.

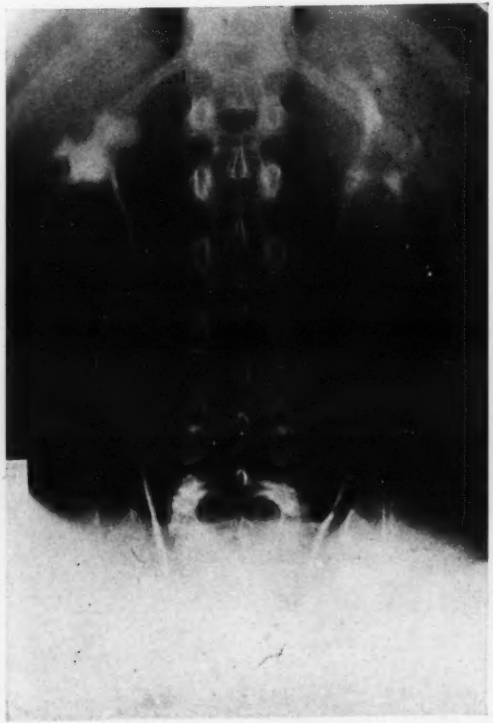
Frieburg's (1884) case, quoted by Schwartz (1895), of a girl of twenty-three weeks of age had a cystic dilatation of the vesicle end of one ureter similar to the case that I mentioned. Pawloff also mentions a similar case.

I have never seen more than two ureters or two pelves, but Braasch has found cases having three.

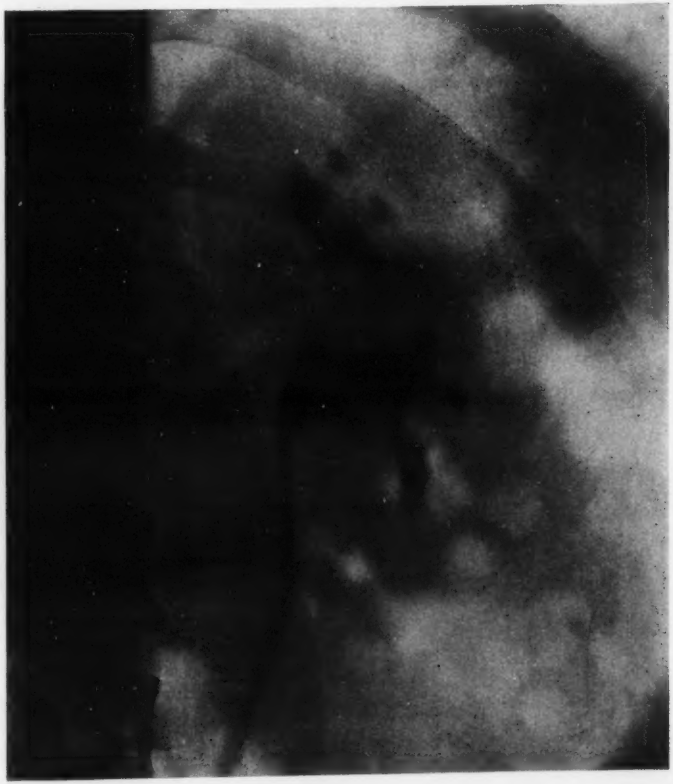
I have not gone into this subject in great detail as it has been so well covered recently.

REFERENCES

(1) Schwartz, C.: Beitr. z. Klin. Chir., xv, no. 1, 59–244.
(2) Pawloff, A.: Dent. Ztsch. f. Chir., cxxi, no. 5/6, 425–446.
(3) Harpster, C. M.: Jour. Urol., viii, no. 6.
(4) Braasch, W. F., and Schall, Albert J., Jr.: Jour. Urol., viii, no. 6.



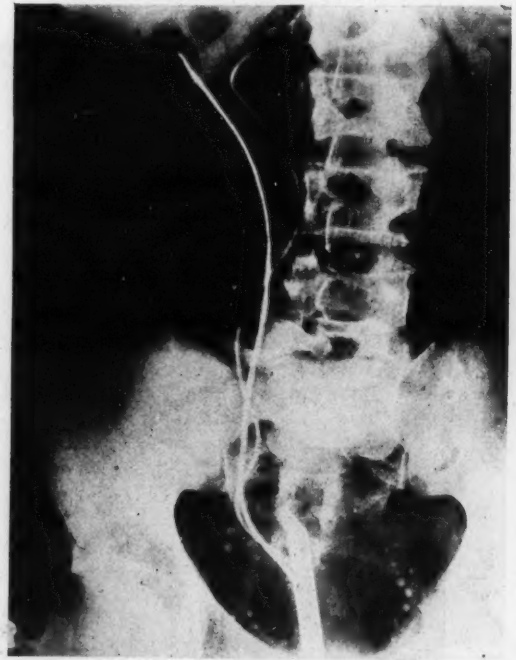
CASE 1. SHOWING BIFURCATION OF KIDNEY PELVIS. HYDRONEPHROSIS ON THE OTHER SIDE



CASE 2. SHOWING BIFURCATION OF THE RENAL PELVIS

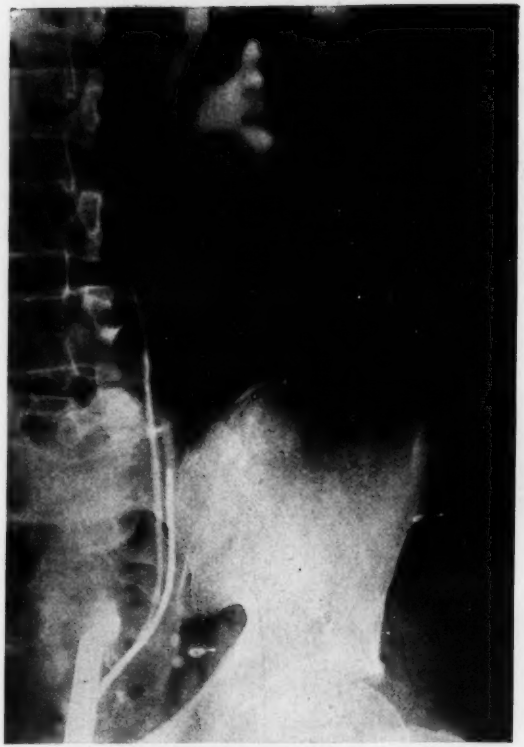
CASE 3. SHOWING BIFURCATION OF URETER OPPOSITE THE THIRD LUMBAR VERTEBRA. MODERATE HYDRONEPHROSIS

CASE 4. URETER BIFURCATING OPPOSITE THE THIRD LUMBAR VERTEBRA. KIDNEY NORMAL



CASE 5. DOUBLE URETERAL OPENING, INTO BLADDER, DOUBLE URETERS AND DOUBLE KIDNEY PELVES

CASE 5. BOTH URETERS INJECTED SHOWING LOWER HALF LARGER THAN THE UPPER



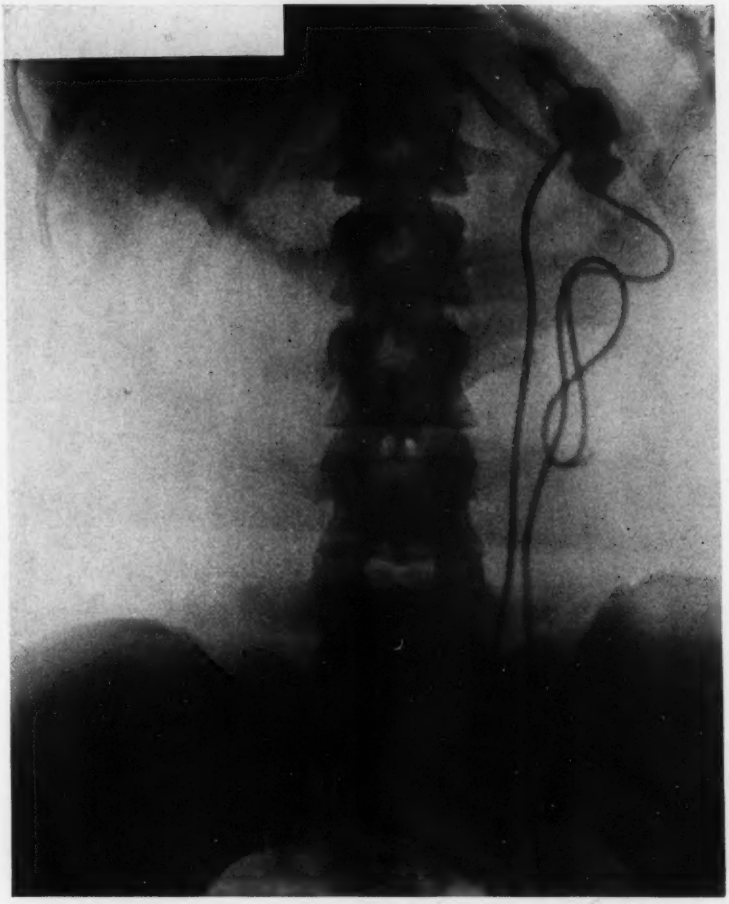
CASE 5. BOTH URETERS INJECTED SHOWING MODERATE HYDRONEPHROSIS

CASE 6. LOWER POLES INJECTED

Note no connection between upper and lower calyces.

CASE 6. BOTH URETERS INJECTED AFTER OPERATION

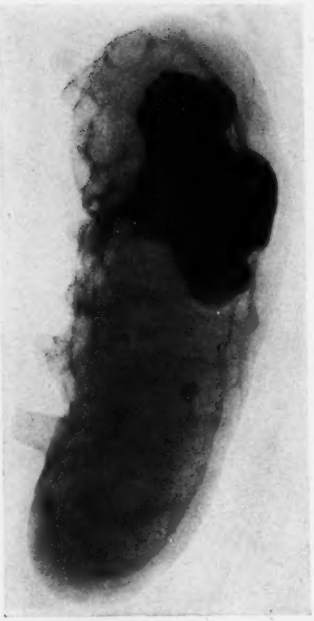
Note no external demarcation between upper and lower poles.



CASE 6. LOWER URETER IN BLADDER INJECTED, FILLING UPPER PELVIS

CASE 6. DOUBLE URETERS TO THE BLADDER-CYST AT LOWER END OF ONE URETER. CATHETERS IN PLACE

CASE 6. BOTH URETERS INJECTED SHOWING MARKED DESTRUCTION OF BOTH HALVES OF KIDNEY



CASE 7. UPPER URETER INJECTED

CASE 7. BOTH URETERS INJECTED AFTER REMOVAL

No external demarcation. No connection between upper and lower sets of calyces.

DISCUSSION

Dr. JOHN R. CAULK (St. Louis): I feel a warm spot in my heart for the type of kidney Dr. Townsend has reported, a calcareous cyst, and if you will permit me, I would like to show a miniature, which I reported before this Association as a thesis for admission; hence, the warm spot.

The cyst in the case I reported was due to a obstructive calcareous papillitis. The cyst was the size of a large cherry. I removed it through a nephrotomy incision. The patient has remained well since. This localized condition in the papilla speaks in favor of the theory of Virchow and Rayer that such cysts are due to a pyelo-papillitis fibrosa.

Dr. O'Neil's paper has been particularly interesting to me. I have just reported in the Annals of Surgery 6 cases of ectopic kidney, in 4 of which cases the mate occupied its normal position, 3 of these mal-posed were hydronephrotic and 1 tuberculous. They were all at the promontory; 3 were on the left and 1 on the right.

The chief thing I wish to speak of is the clinical application of simultaneous routine X-ray and ureteral catheterization in every suspicious kidney disease since it is only through this that such cases may be detected. In my series there were two fused ectopic kidneys. In 1 patient the unilateral fused kidney was $9\frac{1}{2}$ inches long and $5\frac{1}{2}$ inches wide. There was no line of demarcation, except a slight furrow. This woman was bedridden and had almost complete incontinence because the mass crowded the pelvis. I did a fixation on this patient. There was a large vessel coming to the lower pole which was ligated. This allowed the kidney to be lifted about an inch. Numerous stitches of the lumbar fascia anchored the kidney. The patient received great benefit.

Here is an interesting cadaver specimen which Dr. Terry of the Department of Anatomy allowed me to present. It is a

fused kidney of the central type lying transversely in the pelvis below the bifurcation of the vessels. Blood supply came chiefly from the middle sacral.

There are two very interesting anatomical developmental features about such kidneys. They are never surrounded by perinephritic fat, but always lie bare in the pelvis. The fat being in its normal position, I noticed in this one case of perinephritic abscess originating in a tuberculous upper pole of an ectopic kidney. The other feature which I have observed in these kidneys is that the adrenal body is always in its normal position in the perinephritic fat. Hence, these two structures have nothing to do with the development of the kidney.

There is one important point in the surgery of the ectopic kidney and that is the adequate exposure. Such kidneys are almost invariably tightly fixed in the pelvis lying against very important structures with aberrant vascularity, and unless free exposure is given the surgery can be very hazardous.

I can suggest the cross incision which has given me freedom of manipulation, that is, the ordinary low oblique incision, as for instance, for ureteral calculus, then the cross incision of the rectus fascia; in this way the tumor is laid bare.

Dr. Francis R. Hagner (Washington, D. C.): This certainly is a wonderful presentation that we have had this afternoon. We all realize that these abnormalities have been found for many years, and most of them at autopsy, showing that a great many of them give no symptoms. But when we have a patient with an abnormal kidney it means that we have to study the case more carefully to prevent making the mistake of attributing symptoms to the abnormal kidney that may be caused by some other condition. We have recently had such a case. A woman had severe attacks of pain in the right side of the abdomen. The pain involved both the kidney region and the gall bladder, there being radiating pain in the shoulder. On ureteral catheterization a double branching ureter with two separate pelves were noted. As there was no retention in the kidney and the urine was normal, we decided her condition was not due

to her abnormal kidney. She was operated and 200 gall stones removed from the gall bladder.

Dr. BRANSFORD LEWIS (St. Louis): I wish to confirm the fact that these cases, although of abnormal development, do not always need operation. About 1906 I reported 1 of the earliest of 3 ureter cases that had been discovered and proved up to that time. One was duplicate ureters, with infection of the lower urinary tract five years previously. By three argyrol irrigations he was relieved and disinfected and has been well ever since. He is now married and has children and is entirely well.

Dr. GEORGE GILBERT SMITH (Boston): I would like to show two slides which illustrate a point which I think is of interest in regard to these anomalies, and that is that the patients are apt to come to you because of hematuria. This picture shows the bifurcation of the ureters with hematuria coming from the lower pelvis. The man was passing bloody urine from the right orifice. By the catheter we drew perfectly clear urine. When injecting the upper pelvis, the fluid also entered the lower ureter.

This man also had a hematuria. We made a diagnosis of horseshoe kidney. We thought we could feel the isthmus across his spine, and you will notice the calyces on both sides are turning in. I noticed afterwards in an article by Braasch that he refers to anomalies of this type as being characteristic of horseshoe kidney.

Dr. A. L. CHUTE (Boston): I would like to refer to a case I had in which the usual rule regarding double ureters was reversed. In this patient there were two ureteral openings in the bladder, but the two ureters joined a short distance above the bladder to make one ureter. This we determined in the preoperative study. At operation I removed a hydronephrotic kidney. Investigation of the kidney while in position and after nephrectomy failed to show a second ureter. I have no explanation of the condition.

Dr. RICHARD F. O'NEIL (closing): As far as we have been able to find from autopsy statistics, ectopic kidney apparently occurs in from 1 to 1000 to 1 in 2500 cases. It is interesting that the clinical cases have only been observed during the last twenty years, since modern renal diagnostic methods have been in use.

Dr. THOMAS F. LAURIE (closing): About six months ago this patient came into my office one evening and we removed a stone about the size of a cherry pit from the bulbous urethra. I think this was one of the stones which were in the left kidney. I regret that I have been unable to furnish further data on this man, but he was extremely difficult to handle. I hope some day to do some more work on him. This case is contrary to the usual malformations of the kidney, but is embryologically possible.